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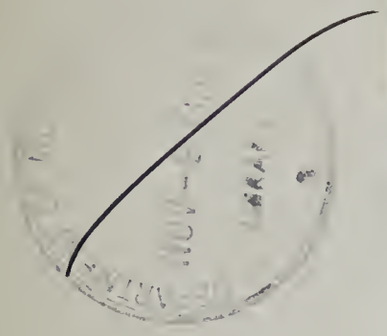

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A
Report
to the
Ontario
Department of
Economics and
Development

THE IDENTIFICATION OF 'GROWTH POLES' IN EASTERN ONTARIO

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Gerald Hodge

eeqb

THE IDENTIFICATION OF 'GROWTH POLES'

in

EASTERN ONTARIO

by

GERALD HODGE

Research Assistant:

Graham Murchie

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A Report To The Ontario Department Of Economics & Development

July 1966

FOREWORD:

The major purpose of this study is to provide a perspective on the structure of urban development in the Eastern Ontario Region within which the Province of Ontario may view various policies that affect urban centers. The identification of a specific set of "growth poles" is not included here. This is a task that is highly involved in policy making affecting many agencies of government. The perspective on urban development that is presented offers a way of probing such policy questions as the kind of growth, and the kinds and locations of growth centers based upon a sound statistical and analytical base.

Although the two main analytical techniques used in this study, factor analysis and multiple regression analysis, are accepted forms of statistical analysis, their use in studies of economic development is only emerging. Similar research has been conducted into the development dimensions in international development situations, among the counties of Ontario and New York States, among the cities and towns of Saskatchewan and Prince Edward Island, and within urban areas. However, the particular combination of the two techniques used here is somewhat unique in development studies of systems of urban places in a region. Furthermore, such a model has never heretofore been used to provide analytical power in the formulation of public policy about an array of urban centers.

One reason for the uniqueness of the technique must be grasped at the outset. This research assumes that development situations are complex, that it is not sufficient to describe them or to prescribe for them on the basis of single variables. Just knowing the size of population of a center, or the income level of the people, or their education level, or quality of housing they inhabit is not enough, if one doesn't know how they are interrelated and how in their interrelated way they affect the process of development. This study proceeds, therefore, in terms of clusters of variables that are linked to one another. A number of clusters are identified in the study as being common to the development situation of Eastern Ontario urban places. Although they are given names such as Physical Development, Population Age, or Education Level they are in reality syndromes of characteristics suggesting conditions about education, and so on. Approached in this way, an acknowledged complex development situation can be seen for all its complexity. And programs and policies for improvement can know the full range of variables with which they must contend.

I wish to take this opportunity to express my appreciation of the work done by my research assistant, Mr. Graham Murchie; for the assitance of Mr. Donald Stevenson and his staff at the Economics Branch; and for the cooperation and interest of members of many other public and private agencies who helped us obtain data and who listened and criticized us at various stages of the project.

In particular, I wish to thank the Province of Ontario for giving me the opportunity to carry out this type of research project. It has, I'm sure, broken new ground in the realm of regional development. I hope the findings can be translated into meaningful policies for the province's future urban system.

July 1966

GERALD HODGE

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PART 1

PERSPECTIVES FOR THE STUDY

URBAN CENTERS IN REGIONAL DEVELOPMENT

For some time past, there has been considerable interest and concern over the continued concentration of people in large urban areas. Meanwhile, little attention had been turned to those regions that were either not urbanizing or were losing their populations to metropolitan centers. But, suddenly, interest on the latter regions has crystallized in a bevy of new public programs such as ARDA (for improving marginal agricultural areas), ADA (for assisting high unemployment centers), Atlantic Development Board (for coordinating development expenditures in that region), and BAEQ (for rejuvenating the eastern Quebec rural region). In large measure, these programs represent an acknowledgement on the part of policy-makers of the need to distribute wealth among areas as well as among social classes; and that it is just as important where resources are allocated as which resources are allocated.

For the process of economic development in any province has a spatial dimension that is as important as the dimensions which define the volume of economic activity and the per capita distribution of wealth. A national, or provincial, territory, for example, is not comprised simply of centers of rapid growth or areas where the economy is stagnant. Each region can, upon examination, be seen to have organized its activities into a pattern of settlement that allows the material and locational advantages to be exploited. The pattern of settlement is structured on a system of cities, towns, and villages and the sites of non-urban activities (such as farms and mines) all interconnected by a transportation network. A basic characteristic of settlement patterns is the arrangement of urban centers into a hierarchical array which reflects the varying capacities of centers to supply goods and services.[1] That is, one finds a few large centers serving the specialized needs of people and businesses over large areas and many small centers serving the common daily needs of local areas. The centers are sustained in this role by the degree to which they are nodes for transportation routes. The urban nodes along with their transportation connections are the bases of the spatial dimension of economic development and are the foundation for what is sometimes called the regional space economy.

Urban centers, thus, are important in the economic development of a region. They are not only vital for providing goods and services to a region's productive activities, but they are also concentrations of investment in business firms, factories, housing, and community facilities.[2] However the prospects for all centers in a region will not be equally bright, according to past experience in Canada.[3] The small center is particularly vulnerable to decline or stagnation because it has little to offer in attracting additional economic activity. But many other centers, big and small, face population decline in the locale as people are forced off the land. They may also be unable to provide adequate public services in the face of growing public needs and demands.

A primary perspective assumed in this study is that all of the urban centers in a region such as Eastern Ontario must be considered when the prospects for growth of any single center are being examined. In other words, the centers exist as part of a system such that the effects of economic growth and social change redound among them affecting the performance of other centers. This constitutes, then, a broader perspective than that normally found in the newly emerging public programs for area development mentioned at the outset. The latter programs tend to see the space economy as either single growth centers or as stagnant undifferentiated areas. "Growth poles" may exist in conjunction with "depressed areas", and vice versa. Furthermore, there may be different degrees of growth among centers and of depression among marginal areas.

It is the intention of this study to try and clarify the perspective on this complex situation surrounding the spatial dimension of economic development. In particular, the viewpoint will be from urban centers which comprise the settlement pattern of the region. The analysis will attempt to determine whether there are common features which distinguish the centers in the study region and, thereby, allow us to understand better the structure of development. This knowledge will then be examined to determine whether it can help us make better judgements about the course of future growth among the region's centers and thus enhance the quality of public policy decisions.

LOCATION OF THE STUDY REGION

The focus of the study is a 19-county area in the eastern part of Ontario, called here Eastern Ontario (see Figure 1). The study region covers 19,700 square miles and comprises both the Lake Ontario and Eastern Ontario Development Regions as designated by the Government of Ontario.[4]

The main center of the region is Ottawa with a population of around 400,000 in its metropolitan area. The region also contains the major part of the Canadian portion of the St. Lawrence Seaway and also lies astride the Montreal-Toronto axis. The Canadian Shield projects into the region from the north. Along with these characteristics the region has several extensive areas of depressed agriculture, particularly in the far eastern counties. The northern counties are subject to forestry and mineral exploitation and, more recently, have become subject to widespread tourist and recreation development. The southern and western counties are tied to agriculture and industrial development, each of a fairly substantial nature.

There are 80 incorporated cities, towns, and villages in the region. They range in size from a few hundred persons to several hundred thousand and encompass all the major centers of the region. There are just over 300 additional nodes of urban activity, but most of these are small villages or hamlets. In some of the analyses all centers are taken into account, but for the most rigorous techniques, requiring good data, only the incorporated centers are used.

RESEARCH AND POLICY OBJECTIVES

As Canadian society becomes increasingly urbanized in its outlook and metropolitanized in its organization, the problems of our many non-metropolitan communities becomes acute. The prospects for many would seem to be stagnation or decline. But this is not the inevitable prospect for all non-metropolitan centers, especially if there are viable aspects to the area's economy. And many centers might benefit from various programs of public investment which locate public facilities within their domain. However, it is almost axiomatic that not all urban places in a region can expect to share in the limited possibilities for economic development or in the limited public resources for capital investment. Many, whose urban accoutrements are meagre and whose quality of physical development is not high, start with a handicap in attracting population and investment.

If, as already has been noted, urban centers are keys to a region's development and public policy ought to be cognizant of urban systems and their trends, then the problem is one of distinguishing the prospects for growth or decline of all urban places in the region. A solution to this problem cannot proceed very far before one has to acknowledge the considerable complexity of urban centers individually and in combination with other centers. It must also be acknowledged that there is no tenable theory on this question against which one might test the centers of Eastern Ontario.

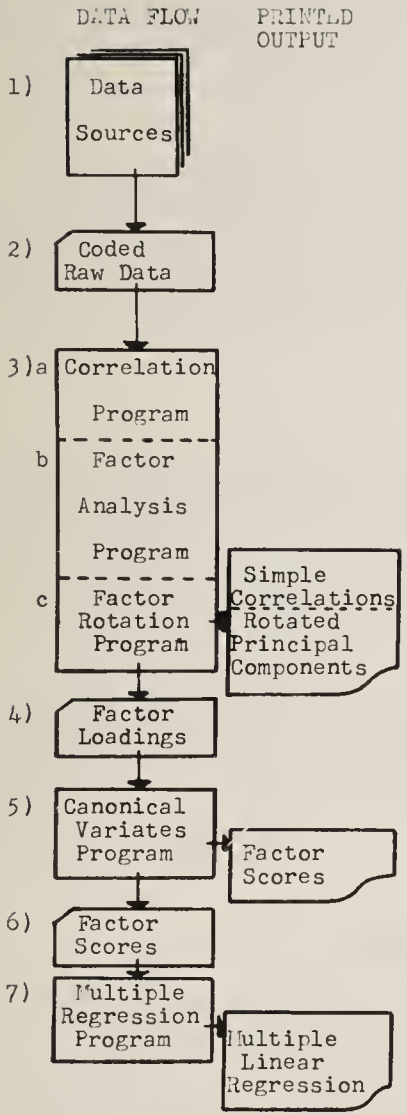
The problem must, therefore, be confronted through an inductive approach. That is, by analyzing whether there are "strategic and relevant" ways in which urban centers differ from one another such that their growth might be affected. The inductive approach need not be completely unstructured, however. There are two basic postulates that can be used to guide the research: First, urban places in relatively homogenous regions do differ in strategic ways that affect their ability to survive -- there is a variety of evidence that such attributes of a center as population size, a history of sustained population growth, the possession of certain public facilities, the level of retail services, or the accessibility to surrounding areas determine chances for survival? And, second, urban places do not constitute an illogical pattern of an infinite number of elements without function meaning -- there are readily observable relations such as large populations being associated with high densities, a well developed public utilities system, an efficient local government, and a large proportion of the labor force employed in service occupations.

Urban communities may then be thought of a groupings of persons interacting within a social, economic, and physical environment. They will affect that environment and be affected by it in such a way that the particular combination of people, housing, and jobs that might exist in a center will result in conditions, or traits, which exhibit some regularity and uniformity. These traits could then be used to characterize the communities under study. Refining further the analytical problem, it emerges that one must determine which variables are most closely associated with one another, among the many against which community differences can be measured. A rigorous statistical analysis would allow us to explore these associations among variables and to discover whether they might be considered common structural features of the region's centers. Our first objective may be stated thusly:

1) To identify the underlying structural features which distinguish the present development of the urban centers of Eastern Ontario.

The attainment of our first objective will provide a description of the complex relationships which characterize the present development of the region's urban centers. It will tell us what is there now and thereby provide an explanation of the existing situation. But it would also be useful to know how present conditions are related to the possibilities for growth or decline of centers. A second objective thus becomes:

THE ANALYTICAL MODEL 1



A total of m variables of social, economic, geographic, etc. attributes of n spatial units from the Census of Canada, other government sources and field surveys.

Raw data punched on cards so as to represent a data matrix X, with n x m dimensions

COVAP Package Program for IBM 7094[1]

a. Product-Moment Correlations,[2] the correlation of each m variable with each other variable deriving a correlation matrix R, with m x m dimensions.

b. Principal Components Analysis,[3] reduction of the matrix R to a factor matrix A, m x r, telling the degree to which the original m variables are associated with the r underlying factors by their factor loadings.

c. Varimax Factor Rotation,[4] a rendering of the matrix A so as to state each factor in terms of a small number of variables with which it is most highly correlated, resulting in a new factor matrix V, m x r'.

Canonical Variates:[5] variable (m)scores of the original n units on each of the r' dimensions in the form of a new data matrix F, n x r', produced from normalized test scores and the factor loading on the mth variable.

Multiple Regression Analysis:[6] scores from the matrix F treated as "independent" variables in predicting the performance of "dependent" variables Y_i for each of n spatial units -- evaluating the extent to which each factor contributes to an explanation of Y.

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2. Edward C. Bryant, STATISTICAL ANALYSIS, (Toronto: McGraw-Hill, 1960), pp. 113-135; or other statistics text.

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4. H. F. Kaiser, "The Varimax Criterion for Analytic Rotation in Factor Analysis, PSYCHOMETRIKA, 23 (September 1958), 187-200.

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6. Bryant, OP.CIT., pp. 198-224.

2) To determine whether the structural features of present development are associated with the growth or decline of urban centers in Eastern Ontario.

Ultimately, the understanding and knowledge about the urban system of Eastern Ontario gained in the analyses can be useful in the formulation of public policy. This use will be enhanced if the research is concerned with variables that are relevant in public policy (such as the quality of schools or highways) and with trends in the system which are of strategic importance in assessing change (such as the change in population). The research has thus been designed with this in mind:

3) To clarify those relationships which are both strategic and relevant in the formulation of public policy.

THE METHOD OF ANALYSIS

An inductive approach to the problem of defining the differences among communities, which involves a large number of variables, lends itself to the use of multi-variate statistical analysis. Two such techniques were used here. A factor analysis was employed to help identify any underlying community traits common to all centers. The traits thus uncovered emerge from the analysis as clusters of the original variables, of which a total of 32 were used in this study. One of the great advantages of this technique is to reduce the large number of variables to a more manageable number of clusters. Because of their statistical properties the clusters, or factors, may be thought of as dimensions of urban development. That is, they may be used just the dimensions of distance, or weight are used to describe situations and make comparisons in the world around us in terms of numerical differences. The dimensions were then examined to determine whether their existence in the region's centers could help in making more precise predictions about the growth of the centers. A multiple regression analysis was used to ascertain the degree of association between the various dimensions of urban development and community performance. The main features of the computational procedure and its theoretical basis are given in the accompanying diagram for those desiring to examine the details of the analytical model that was employed.

The input for the factor analysis consists of a series of indices that are thought to have some bearing on the problem of growth and decline of urban places. A total of 32 relating to the characteristics of the population, the economic base, the geographicl location, and the physical development of each center entered into the present analysis (see Table 5). On the basis of the intercorrelations of these variables the structural relations among the indices are defined. A large number of variables are thus expressed in terms of a relatively small number (usually six or seven) linearly independent factors. The factor analysis does not simply sort out the variables into groups, each containing a certain number of characteristics. Rather each factor gathers together the variables that are most highly correlated with one another. All centers may then have scores derived indicating their position on each of the factors. If each dimension can be shown to represent relevant traits (and are not just mathematical conveniences), then each center will possess some degree of each trait. The particular configuration of traits possessed by a center is the basis of describing it for this study.

The apparently valid dimensions of urban places can then be tested to determine whether they linked, and to what degree, with changes in the recent past by means of multiple linear regression. The factor scores are treated as independent variables in a regression model which literally tests the following hypothesis: change in urban centers is dependent upon certain structural relationships present in the urban environment. The dependent variables of urban change included population growth, change in number of retail firms, and change in assessed valuation. Other dependent variables which might be used as criteria of development, such as family earnings, can also be tested in this model. The role of the model in relating these findings to the public policy area is described below.

THE ANALYTICAL MODEL AND URBAN POLICY

According to our third objective, this study has been conceived to provide information of direct use in public policy formulation regarding the future of urban centers in the Eastern Ontario Region. The analytical model and the results obtained from it do not, however, presume any particular policy. The prime intent is to provide a sound statistical base from which "growth poles" can be identified by those making policy involving urban centers. The task of policy making is a complex one and is recognized as such by this study. It involves very deeply the question of values and goals about urban development location, type, quality, intensity, and form. Clearly, this aspect is beyond the scope of this study. But it is also recognized that policy making about urban centers must begin with an appraisal of the present situation in order to know both the starting

point for policy and the possible constraints on that policy. With this aspect of policy making the model developed in this study can be of considerable assistance.

The analytical model is not a set of interlocking equations so much as it is a set of interlocking statistical analyses. It features a sequence of statistical outputs each of which could have one or more uses in policy formulation and maintenance (see Figure 1). These various outputs are described below along with some relations with policy that might prevail.

First, a study of this type generates a large amount of basic data. A total of 32 variables for 80 urban centers was gathered, or nearly 2,600 pieces of data. They are the prime ingredients for all the analyses and, thus are reflections of the world with which the study deals. These "raw" data provide an important way of obtaining and maintaining a perspective on the problems of urban development in the region. The variables are identified in Table 5.

Second, the initial step in the analysis is to produce a matrix of the relationships among the variables used to describe urban centers. The correlation analyses help in clarifying many of the complex relations which exist in the present development situation in Eastern Ontario. If, for example, one wished to know the relationships between population size and ethnic composition, education level, or family earnings such can be found in the correlation matrix presented in Table 6.

Third, the factor analysis identifies underlying structural features of the development situation in the region. The dimensions that are uncovered could be basic to many other investigations of the region as well as for urban center growth. This analysis thus provides a concise statement of the dominant sets of relationships that exist among the variables. It is these relations that must be affected if it is desired to change the course of present urban development. Some of the factors that have been uncovered such as Physical Development, Education Level, or Industrialization may also reflect problem conditions among centers. Since the factors, or dimensions, are actually clusters of variables, we can then know the range of variables that will have to be affected by programs aimed at correcting problems. A low level of Physical Development, for example, is found in conjunction with poor housing, poor high school, low family earnings, and low educational attainment. Table 7 gives the composition of structural dimensions for Eastern Ontario.

Fourth, the dimensions extracted in the factor analysis may also be used to describe geographical differences in development. The position of cities, towns, or villages on each of the dimensions can be mapped and may be a useful diagnosis of problem conditions in a center. The factors, can, therefore, be used to identify problem areas as well as problem situations. For example, those centers possessing a low level of physical development, or education level, or industrialization can be pinpointed. The relevant maps for the region are shown in Figures 5-11.

Fifth, from the analyses of past performance in population growth, etc., (using the multiple regression technique) there is evidence that differences in structural features between centers affects performance substantially. That is, the possession of certain attributes as defined by the development dimensions will reflect capabilities for certain kinds of growth. For example, it appears that population growth is related closely to a center having a young population and not being a predominantly industrial center. See Tables 10-12.

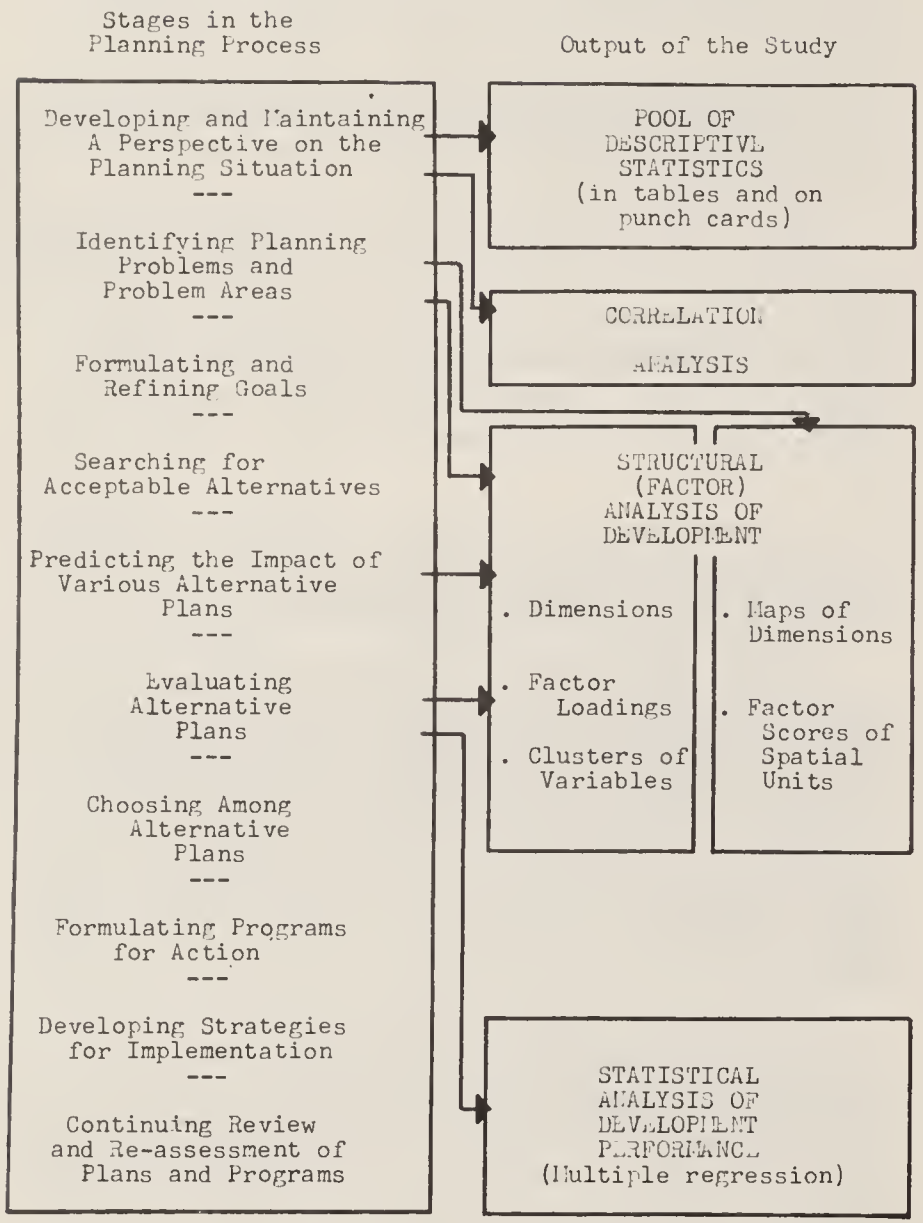
Figure 2 portrays some of the more important relations between the analyses undertaken here and various stages in a typical planning process. The five points just elaborated follow this diagram generally from top to bottom.

As indicated earlier, the various results from the analyses are useful in describing and appraising the present development situation for the urban centers of Eastern Ontario. In other words, the results are directly useful in knowing how development might proceed if present policies of the government, attitudes and abilities of the population, distribution of resources, performance of markets, and so on, continued. This is important, for if we know where present conditions might lead, we shall be in a position of knowing which problems and which centers are most in need of attention. Thereby, we will then be in a better position to know where best to allocate limited resources and direct planning efforts.

These analyses have an additional benefit for planning and programming. They can help in assessing the practicability of alternatives that might be put forward to encourage changes in the development situation. For example, a program of improvement in education were suggested the conditions with which it would have to cope in various parts of the region could be determined from the structural (factor) analysis. It would show that private investment in the community and level of family earnings are bound up with educational attainment levels. Or if a program of industrial development depended on a young resident population in a center, this could also be assessed.

2

RELATION OF THE PLANNING PROCESS TO THE CAPABILITY ANALYSIS



It is not within the scope of this analysis to recommend centers of "growth" in Eastern Ontario, nor to advocate particular courses of action to achieve growth in centers. All the centers that are presently growing may not prove to be the best array given certain programs for economic development. It may be perfectly consistent with development policy to subsidize the growth of some lagging centers that are, nevertheless, strategically located for policy purposes. But the analysis can help in assessing the reasonableness of the goals the policy-maker may suggest; and it can help in evaluating the feasibility of programs of action. Finally, the analyses cannot provide evaluations in precise, absolute terms; our theory about the relation of urban and economic development is just not that strong. They can, however, reduce the degree of uncertainty about the choice of growth centers called for in plans for urban development.

URBAN CENTERS AND RURAL POVERTY

The region of Eastern Ontario has been the subject of a number of studies in the past two years because of the prevalence of much marginal farming there. The Federal ARDA program has been the impetus for many of these studies. Of particular relevance is the study of rural poverty by Professor Berry of the University of Chicago completed a year ago.[9] Berry's research is significant for the present work because not only does it afford a comprehensive view of the region's rural townships but also uses the method of factor analysis in order to distinguish the dimensions of rural development. Clearly, the development of urban centers should be seen in the perspective of their adjoining rural areas, and vice versa. An attempt is made to provide such a perspective in this study by integrating some of the findings of the two researches. In this way it is possible to give a much more substantial view of a functioning space-economy.

PART 2

THE SYSTEM OF URBAN CENTERS IN EASTERN ONTARIO: STRUCTURE AND TRENDS

The very aim of this study "to identify growth poles" among urban centers acknowledges that centers differ from one another. They differ in their "growth" potential and, furthermore, the process of "growth" among some centers produces differential changes throughout the whole array of centers. These are the implications. These notions are also implicit in the general concern over the effects of urbanization. Metropolitan communities appear to be able to sustain growth while many smaller centers appear to face long-term stagnation or decline. Yet the picture is not entirely clear regarding the prospects for growth and decline among urban communities. In order to uncover the reasons why some centers grow and some do not requires a means of relating the ways in which communities differ from one another to the ways in which communities perform.

A broad perspective on this question, covering all centers in the Eastern Ontario study region, was achieved by classifying each center according to its commercial structure in 1951 and observing any change in it over the ensuing decade. The relevance of this approach is that it is on the basis of differences in commercial structure that most communities owe their existence within a system of urban centers. Commercial structure defines the kinds of goods and services a center can provide to its own and surrounding populations, and thus, the extent of territory over which a center can claim trading primacy. Although this analysis does not allow predictions for individual centers, it has the value of illuminating the structure of the system of urban centers existing in the region and of suggesting future prospects for different levels of centers.

THE PRESENT SYSTEM OF URBAN CENTERS

There were a total of 392 urban centers in Eastern Ontario in 1961[1]. These centers comprised a hierarchically-arranged system of centers in which the different levels reflect the different functions they perform. Seven levels of centers have been identified in this region, corresponding closely to commercial service hierarchies of centers found elsewhere.[2] The seven classes, in ascending order, are Hamlets, Minimum Convenience centers, Full Convenience centers, Partial Shopping centers, Complete Shopping centers, Secondary Wholesale-Retail centers, and Primary Wholesale-Retail centers. The basis of the classification system is the array of commercial activities found in a center. Thus, as centers are found to offer more specialized goods and services they are placed at a higher rank in the hierarchy; they still continue to offer the less specialized goods and services. For example, Belleville offers all the goods and services found in the smaller center, Deloro, but not as many as offered in Kingston.

The types of centers are generally characterized by the possession of the following services. Hamlets offer at least one general store or grocery store and one more retail establishment, usually a service station. But as many as seven firms may be found in some hamlets. Minimum Convenience centers may provide in addition to hamlet level services such things as a farm machinery dealer and a restaurant, accounting for 8-15 establishments. Full Convenience centers may offer as many as 25 establishments covering such goods and services as hotel, bank and hardware. Partial Shopping centers may provide several specialized establishments not found in lower level centers, including electrical repair, bakery, appliances, clothing and dry goods and morticians, among their 26-45 commercial firms. Complete Shopping centers offer such services as a jeweller, furniture store, and a dry cleaners as well as displaying greater strength in the services offered by lower level centers. These centers also display some wholesale functions such as in food and auto parts. Wholesale-Retail centers possess the highest level of retail specialization found in the region as well as offering a wide array of wholesale functions, transportation and financial services, and public activities. In Table 1 can be seen the number of centers in each class in 1961, their median population size, and the average number of commercial firms found there. The location of these centers is given in Figure 3.

The geography of the region, with the constraints of the two major river valleys, the Ottawa and St. Lawrence, and the Canadian Shield, tends to preclude a symmetrical pattern of centers such as theorized by Christaller and Losch. The heterogeneity of the region's economy further reinforces this tendency. We may, however, examine the spatial distribution of centers in terms of their density and spacing. The latter characteristics are important in indicating the relative accessibility and competitive position of various types of centers.

The number of centers per unit area is a good measure of both the range of choice of trading places accessible to the population as well as the degree of competition existing

EASTERN ONTARIO

System of Urban Centres : 1961

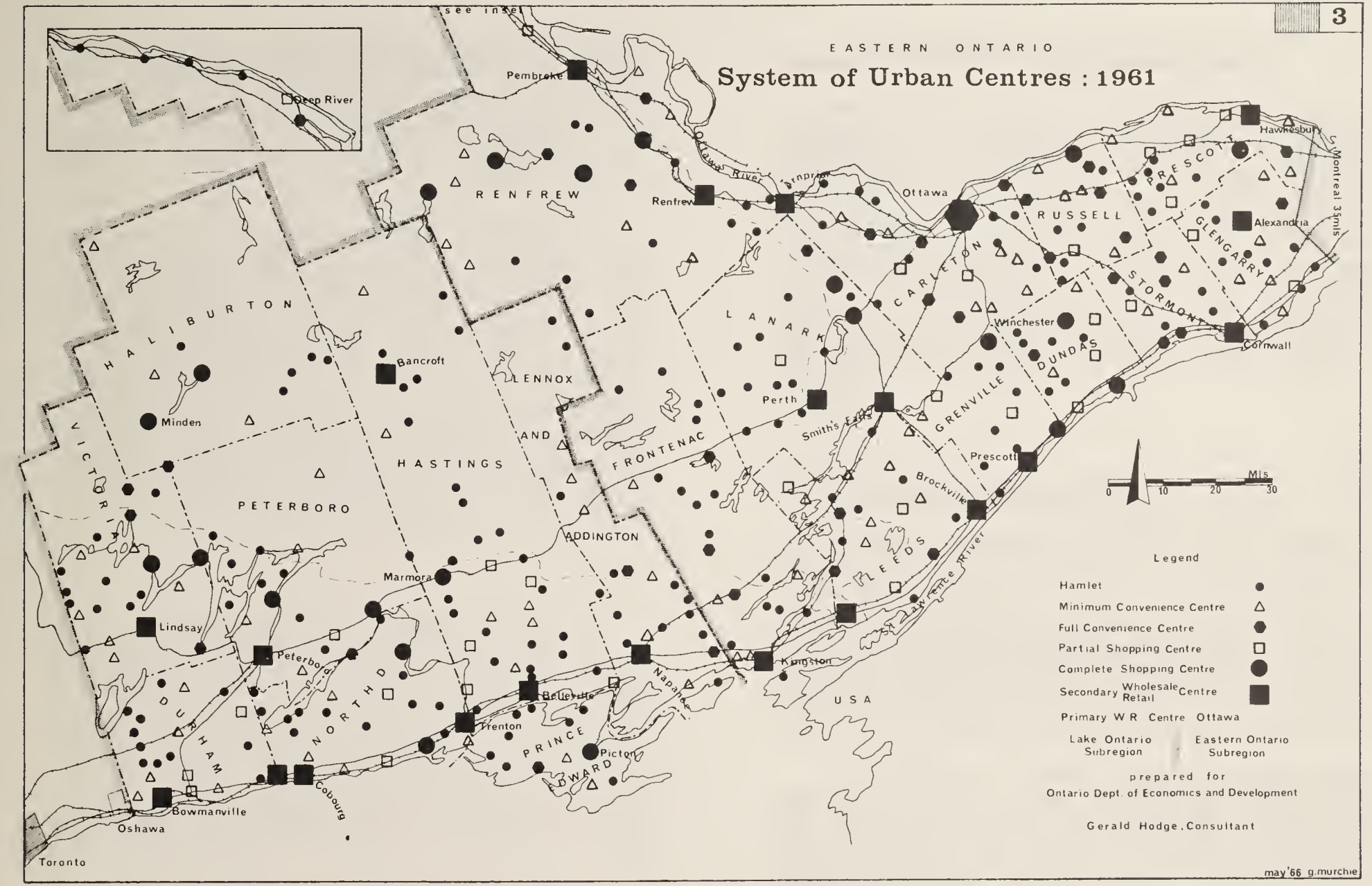


Table 1: Number, Median Population, Average Number of Firms by Level of Urban Center, Eastern Ontario, 1961.

Level of Center	1961 Centers No.	%	Population Median	Average No. Firms
Hamlet	194	49.5	113	3.98
Min. Conv.	83	21.2	235	10.89
Full Conv.	38	9.7	502	20.00
Part. Shop.	32	8.2	1035	34.90
Comp. Shop.	22	5.6	1775	60.40
Sec. W-R	22	5.6	8790	196.14
Prim. W-R	1	0.3	268206	1730.00
Total	392	100.0	---	---

Source: Dun and Bradstreet, REFERENCE BOOK, 1961, and Census of Canada, 1961.

Table 2: Aggregate Changes in the System of Urban Centers of Eastern Ontario, 1951-1961

	No.	%
No. of Centers in 1951	441	100.0
No. of Centers Emerging in Period	28	6.4
No. of Centers Expiring in Period	77	17.4
No. of Centers Declining in Period	52	11.8
No. of Centers in 1961	392	--

Source: Dun and Bradstreet, REFERENCE BOOK, 1951, 1961.

among centers for the available customers. It is most useful to indicate the density for each class of commercial services rather than for discrete classes of centers. That is, for a certain class of service, the number of centers supplying it is a total of the centers in that class and of the centers in the classes above. For example, a family may obtain hamlet-level services at all hamlets within the area it normally frequents as well as at all higher level centers accessible to them.

Two facets of the system of centers can be seen from such an examination. First, the density of centers offering similar services is generally high. On the average, for centers offering the basic necessities of hamlet services, there were 20 such centers in every 1,000 square miles. This means that within a radius of less than 18 miles or, conservatively, one-half hour's drive a household in Eastern Ontario would have access to 20 centers offering hamlet goods and services, on the average. Moving further up the hierarchy, the household would have access to two complete shopping centers within the same time-distance radius. Second, it can be seen that the densities differ between the two development regions -- they are lower in the west than in the east. One probable explanation lies in the corresponding differences in the rural population densities in each sub-region. Higher densities of resident population will, all other things being equal, require more centers to service the population, and vice versa.

Another way of measuring the ease of access to centers is by examining their characteristic spacing. Again, as with density, distance between centers offering similar levels of services, is the better measure, i.e., all the centers in a class plus all higher ranking centers. At all levels the spacing of centers in the Eastern Ontario Development region is higher than, or the same as, the spacing of those levels of centers in the Lake Ontario Development region. However the differences are small. Probably more significant are the actual distances separating centers. Hamlet level services can be obtained at centers spaced less than 5 miles apart. Or, assuming a circular trading area, within a radius of less than 2.5 miles. Even complete shopping center level services are found, on the average, in centers only 12 miles apart.

These data on density and spacing of centers suggests, clearly, that small centers are too close to one another given the ability and propensity to be mobile among today's consumers.

Table 3: Changes in the Number and Proportion of Urban Centers by Level of Center, Eastern Ontario, 1951-1961

Level of Center	1951 No.	1951 %	1961 No.	1961 %	% Change 1951-1961
Hamlet	240	53.9	194	49.5	-18.9
Min. Conv.	81	18.6	83	21.2	2.4
Full Conv.	43	10.0	38	9.7	-11.6
Part. Shop.	29	6.6	32	8.2	10.3
Comp. Shop.	26	5.9	22	5.6	-15.4
Sec. W-R	21	4.8	22	5.6	4.8
Prim. W-R	1	0.2	1	0.3	0.0
Total	441	100.0	392	100.0	-10.9

CHANGES IN THE SYSTEM OF URBAN CENTERS, 1951-1961

The system of urban centers in Eastern Ontario is significantly different today from that which existed only a decade ago. The most dramatic change has been the decline of a large number of centers. Between 1951 and 1961 in the region there was an absolute loss of 77 centers, or over 18 per cent of the 441 that existed in 1951. Twenty-eight new centers emerged in this period, so the net loss was 49 centers, or nearly 12 per cent of the 1951 total (Table 2). These figures represent an acceleration of trends already begun in the previous decade, 1941-1951. That is, in the earlier decade the net loss of centers was only 32, or about 6 per cent of the total in 1941. In addition, it can be seen that nearly 12 per cent of the centers in the region suffered decline in their commercial status. The proportion of decline and demise of centers was almost the same in both subregions. A geographical view of these changes is given in Figure 4.

Changes in Number and Types of Centers

Changes in the number of centers in Eastern Ontario in the 1951-1961 period did not derive equally from all levels of centers. In general, the lower level centers in the region suffered the bulk of decline and the higher level centers had more tendency to grow. In other words, basic transformations occurred in the whole system of centers. The stability of the two highest levels of centers are in contrast to the marked changes among the hamlets and full convenience centers. Viewing these changes structurally, the three lowest levels of centers showed a combined loss in proportion contributed to the total. The four highest levels, in turn, assumed a larger proportion of the total.

These are not the complete dynamics of the situation, however. We shall still need to look at the changes within each level of center, i.e., the growth, decline, or stability. For this purpose a matrix of probabilities, as in Table 4, which shows how centers performed during the period under study is helpful. This table shows the probabilities (or percentage of chance) particular levels of centers had of remaining in the class they started in 1951 (stable), of falling from their 1951 class to a lower class (decline), or of moving to a higher class than they occupied in 1951 (growth). Figures to the left of the main diagonal of the matrix indicate a degree of decline, the figures on the main diagonal indicate stability, and those to the right indicate growth within the level of center.

Table 4: Growth and Decline within Trade Center Classes, Eastern Ontario, 1951-1961.

Classes 1951	Classes in 1961: Expired by 1961	Hamlet	Min. Conv.	Full Conv.	Part. Shop.	Comp. Shop.	Sec. W-R	Prim. W-R
New center		89		11			GROWTH	
Hamlet	30	61	8		1			
Min. Conv.	4	27	63	6				
Full Conv.	5	2	26	51	16			
Part. Shop.				24	59	17		
Comp. Shop.				4	27	54	15	
Sec. W-R						14	86	
Prim. W-R	DECLINE							100

Table 4 b: Eastern Ontario Development Region, 1951-1961.

Classes 1951	Classes in 1961: Expired by 1961	Hamlet	Min. Conv.	Full Conv.	Part. Shop.	Comp. Shop.	Sec. W-R	Prim. W-R
New center		84		16			GROWTH	
Hamlet	30	59	10		1			
Min. Conv.	7	23	63	7				
Full Conv.	6	3	23	51	17			
Part. Shop.				25	65	10		
Comp. Shop.				7	7	64	22	
Sec. W-R						9	91	
Prim. W-R	DECLINE							100

Table 4 c: Lake Ontario Development Region, 1951-1961.

Classes 1951	Classes in 1961: Expired by 1961	Hamlet	Min. Conv.	Full Conv.	Part. Shop.	Comp. Shop.	Sec. W-R	Prim. W-R
New center		100					GROWTH	
Hamlet	30	62	8					
Min. Conv.		31	64	5				
Full Conv.			37	50	13			
Part. Shop.				22	45	33		
Comp. Shop.					50	42	8	
Sec. W-R						20	80	
Prim. W-R	DECLINE							--

Two important observations about the entire Eastern Ontario region can be made from the vantage point of these data. First, over 95 per cent of all changes in either growth or decline in the decade were one-step changes. The small number of three-step changes can be explained by the demise of centers flooded by the St. Lawrence Seaway construction and the opening of a new mine. The second observation concerns the high degree of instability in all except the two highest levels of centers. Among the hamlets and minimum convenience centers the instability is manifest in decline and disappearance of centers. Among the full convenience, partial shopping, and complete shopping centers the instability shows itself in substantial degrees of growth into higher levels of centers as well as in decline.

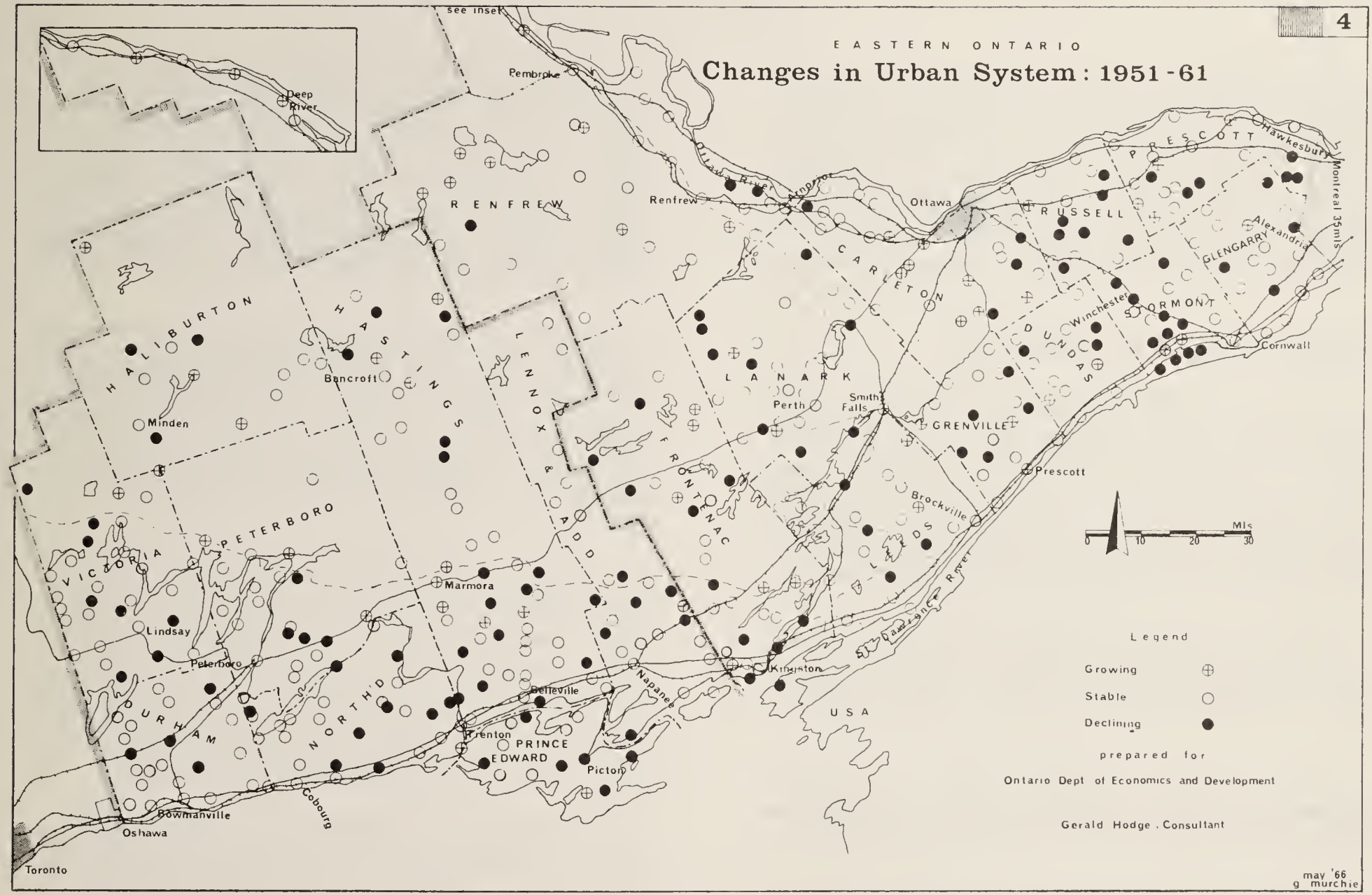
Viewing the matrices that are included for each of the sub-regions some important differences appear in the configuration of changes. First, the shifts between classes in the Lake Ontario sub-region are all one-step shifts, thereby indicating a limited number of forces causing change within that sub-system of centers. Second, the partial shopping centers in the Lake Ontario sub-region show a greater tendency toward growth than in the Eastern Ontario sub-region. In the former region, partial shopping centers that have grown into complete shopping centers include Havelock, Marmora, and Haliburton. The opening of the Trans-Canada highway in this period would help to explain many such changes. Third, complete shopping centers in the Lake Ontario sub-region exhibited decline among half of their numbers. Included in those declining to partial shopping center level were Tweed, Sterling, and Norwood. Some of these declines appear to be due to the new highway by-passing these centers. Finally, the changes in the Eastern Ontario sub-region are much more varied than in the region to the west probably because of the greater heterogeneity of conditions in the former. Thus, centers in the eastern sub-region have been affected by a variety of influences such as the construction of the Seaway, by the depressed conditions in agriculture prevailing in many of its counties, and by the growth of the Ottawa metropolitan area.

Changes in the Spatial Distribution of Centers

Just as the number of centers has declined by nearly 11 per cent, so too has the density of all centers, for the land base remains the same. Since all centers supply at least hamlet level services, this change can be stated as a drop in the accessibility to such services by 2 centers in every 1000 square miles. However, for all levels of services above the hamlet level there were virtually no changes in density (or accessibility) on the average.

EASTERN ONTARIO

Changes in Urban System: 1951-61



Regarding changes in the spacing of urban centers in Eastern Ontario from 1951-1961, the following observations were made. There are increases in the average distances separating the four lowest levels of retail services, but the changes in spacing of the minimum convenience and the partial shopping centers was negligible. Complete shopping center and wholesale-retail level services were found more closely spaced at the end of the period than at the start. Although the lower level centers experienced some "thinning out", the absolute changes in spacing in miles were insignificant given automobile transportation. Sub-regional changes in spacing differed little on the average from those of the entire study region.

PROSPECTS FOR THE SYSTEM OF URBAN CENTERS

The data presented for the period 1951-1961 are clear evidence of a number of fundamental changes in the system of urban centers of Eastern Ontario. Changes have occurred in the number of centers, the distribution of the various levels of centers, and in the density and spacing of centers. These trends are such that, if they continue into the future, they could affect policies and programs aimed at transforming the economy of this part of the province, not to mention their effects on on-going provincial programs. In order to assist in assessing the possible impact on policy areas a brief summary of recent trends in the urban system and an extrapolation of these trends will be helpful.

First, the number of centers showed a net loss of 49 or 11 per cent in the 1951-1961 period. Up to 1971, it is probable that this rate of decline will continue and result in the net disappearance of a further 40 centers. The proportion expiring could go even higher if, as seems likely, the rate of emergence of new centers continues to drop.

Second, a total of 52 centers, or nearly 12 per cent, declined in commercial status from 1951-1961. Assuming a continuation of trends in increased physical mobility and expanding incomes, this trend will continue, if not increase, thus affecting about 50 centers in the present decade.

Third, those centers supplying minimal day-to-day needs were most affected by decline. There is little reason to expect that trend to change in the period 1961-1971, for these generally small centers are able to attract little of any increased income (which usually goes for purchases of more specialized goods and services) and they may even be by-passed, or substituted for, in any shift to shopping at larger centers with their greater variety.

Fourth, there have been declines in the density of small centers and increases in their spacing both of which mean a reduction of accessibility to their goods and services. A further decline in the number of centers will further reduce this accessibility. However, the increased distances still will not be large with the ease of travel provided by automobiles, i.e., a rural resident of Eastern Ontario may have to drive, at the most, two and one-half miles instead of two miles for hamlet level services. With complete shopping centers and wholesale-retail centers becoming more easily accessible, the lower level centers will find themselves in closer competition with one another and with the higher level centers.

Thus far, we have viewed the system of urban centers of Eastern Ontario in terms of two dimensions -- level of retail services and spatial distribution. Many changes in the urban system seem closely related to these two dimensions, but the explanation they provide is still far from complete. For example, there are not progressively increasing rates of decline as the level of centers gets lower. There are incidences of both growth and decline intermixed in the hierarchy of centers. Also, sub-regional distinctions between the Lake Ontario and Eastern Ontario Development Regions offer little additional bases for explaining changes in the urban system.

Returning to the question of identifying the "growth poles" in Eastern Ontario, by these findings it is possible to speak with any certainty only about the future of wholesale-retail centers -- e.g., Ottawa, Peterborough, Cornwall, Napanee, Lindsay, Gananoque, Hawkesbury, Belleville, Bancroft, etc. They have, for the most part, been growing or stable. However, even three centers of this level declined in the period 1951-1961: Campbellford, Picton, and Carleton Place. Also among the larger centers, which one would normally feel to be "growth poles," the complete shopping centers have shown a strong tendency toward decline. Chesterville, Casselman, Cobourg, and Frankford are included in a large group of declining complete shopping centers.

The apparent lack of regularity in the changes when observed only in terms of the two variables used here suggests that we need considerably more clarity about the process of change in the urban system. One way of adding clarity is to try and delineate the structural characteristics of the system and its environment and to relate the changes to these characteristics. Part Three of this report attempts this kind of analysis by inductively determining the structural features of the system and finding out if they are associated with growth and decline of urban centers.

PART 3

THE STRUCTURE OF URBAN DEVELOPMENT

GENERAL FEATURES OF URBAN STRUCTURE

A wide variety of individual statistics are often generated to describe the nature of urban development. Such measures as population size, change, density, and composition, employment levels, income ranges, education, location, capital investment community facilities, and housing quality are used to delimit approximately the extent of development problems and where they exist. A total of 32 different measures, or indexes, were gathered in this study to describe the development situation in the 80 incorporated cities and towns of Eastern Ontario (Table 5). These data in their "raw" form provide a preliminary vista on the problems that exist.

The data showed that the average rate of population change among the region's centers in the 1951-1961 decade was 33.6 per cent growth in numbers. Only six centers showed a net loss in population, but an additional 15 experienced a less than 10 per cent gain in numbers in the period. The age composition of the centers indicated an average of 32 per cent of the population were less than 15 years of age and nearly 12 per cent of the population were over 65 years of age. On the average, among the centers only 3.5 per cent of the adult population possessed full university training: only one-third had completed grade 11 and the figure seldom ran more than 42 per cent. The average gross population density of centers was 7.5 persons per built-up acre, but it ranged from as low as 0.9 per acre (Deloro) to as high as 42 per acre (Eastview). Assessed value of property averaged $882 per person among the centers with one center having only $147 (Newboro) and another having $1927 (Ottawa). The average per capita expenditure on utilities was $71.00 and on other local services the expenditure was $70 per capita. The proportion of physical investment, as measured by assessed valuation, in commercial property was 23 per cent and in industrial property was nearly 10 per cent. The latter indicates, of course, that residential assessment accounted for more than 60 per cent in most cases. Surprisingly, the average age of dwellings showed 70 per cent to be more than 20 years old; only 64 per cent, on the average had furnaces. Employment in services averaged 52 per cent and in manufacturing 25 per cent. Family earnings were $4300 per year and most places were between $3500 and $5000. All these figures are derived from 1961 data.

The fact that so many different variables seem relevant in describing urban areas is indicative of the wide range of influences that are thought to be at work in forming a city or town. No single variable is thus sufficient to describe the true nature of development. But without further analysis the data in their raw form cannot define precisely either the complicated nature of urban development or the areas with the problems. An important first step to rectify this descriptive deficiency is to derive the statistical relationships between all variables. That is, the degree to which one condition of urban development is found to exist in the presence of another condition within the set of centers being examined. An analysis of these correlations has been made and it is useful in itself as well as being the necessary input for the more refined factor analysis.

The statistical relations between all variables are arrayed in Table 6. The relations are stated as numerical values -- correlation coefficients (r) -- and may be interpreted literally as the probability one could expect two conditions to co-exist. One can thus find, for example, at the intersection of column 1 and row 19 that in Eastern Ontario communities as the size of population gets larger there is a 49 per cent chance that the median value of dwelling units will also be found to be high. Or, from the intersection of column 2 and row 3, in communities where the population has experienced a rapid increase in the 1951-1961 decade there is 64 per cent chance that the 1961 population will be found to have a large proportion under 15 years of age. When the correlation coefficient is negative, inverse relations exist between the two variables such as the intersection of column 2 and row 20 which shows that communities with fast growing populations tended not to have dwellings more than 20 years old.

A few other relationships revealed by the correlation matrix are also worth noting. The variables on language (7, 8) and religion (5,6) indicate a high degree of segregation of communities in both cases, but more in regard to language than religion. Also, the housing variables (19-22) are all quite highly intercorrelated and to a limited extent are related to the quality of high school in the community. Another interesting group of correlations is between the variables measuring the extent of industrial/commercial investment and employment in a center (17, 18 and 28, 29). The coefficients indicate the existence of numerous communities serving one or the other function, but not both. The latter relation, it should be noted is not strongly related to either the size of population or the number of retail firms.

It is possible to get a clearer idea of the pattern of relations that exist in the region from these data. We can, for example, perceive that the development situation is complex. But it is difficult to comprehend the overall picture of development that these data appear to be conveying. The

Table 5: Variables Used in the Analysis of Urban Development in Eastern Ontario*

CHARACTERISTICS OF URBAN CENTERS	CODE
Demographic and Social Characteristics:	
1. Population Size, 1961	POPULA
2. Population Change, 1951-1961	POPCHA
3. Population Under 15 Years, 1961	POPU15
4. Population Over 65 Years, 1961	POPO65
5. Protestant Religious Affiliation, 1961	POPROT
6. Roman Catholic Religious Affiliation, 1961	POPRCA
7. French Speaking Population, 1961	POPFRE
8. English Speaking Population, 1961	POPENG
9. Immigrant Population Since 1945, 1961	PIM45
10. Education Attainment of University Level, 1961	UNIVER
11. Education Attainment of Grade 11 or Better, 1961	GRAD11
12. Population Density, 1961	POPDEN
Physical Development:	
13. Value of Private Investment/Capita, 1964	CAPINV
14. Intensity of Private Investment (Value)/Acre, 1963	INTASS
15. Investment in Public Utilities, 1963	UTILIT
16. Level of Locally Provided Services, 1963	LOCSER
17. Investment in Commercial Property, 1961	INCOMM
18. Investment in Industrial Property, 1961	ININDU
19. Median Value of Dwellings, 1961	MVALDU
20. Dwellings Built Before 1945, 1961	DUSOLD
21. Dwellings with Furnace Heat, 1961	DUFURN
22. Dwellings with Hot-Cold Water, 1961	DUHCWA
23. High School Quality, 1963	HSQUAL
24. Hospital Quality, 1964	HSPQUA
Geographic Situation:	
25. Location of Nearest Competing Center, 1961	NEARES
26. Time-Distance to Nearest Metropolis, 1961	NMETTO
27. Highway Access, 1964	HIGHWA
Economic Base:	
28. Labor Force in Manufacturing, 1961	EMPMAN
29. Labor Force in Services, 1961	EMPSER
30. Average Family Earnings, 1961	FAMERN
31. Male/Female Employment, 1961	EMPSEX
32. Level of Retail Services, 1961	LEVRET

* The operational definition of each variable and its source is given in Appendix A.

sheer size of the matrix with its 512 correlations makes it hard to grasp the complexity, except to acknowledge it. The existence of a few clusters of inter-relationships, which have been pointed out, cannot also be systematically examined at this level of analysis. More elaboration of the analysis must be provided and this is accomplished through the factor analysis described below. It is important to note before moving to the factor analysis that the correlations referred to are the basis of all subsequent analysis. That is, since correlations do not allow us to assert positively "causes" and "effects" among conditions of urban development, we must be prepared to speak mainly in terms of "symptoms" of development situations. However, if the relationships appear to have statistical soundness, this kind of diagnosis would be much more useful in policy formulation than the meagre knowledge we now possess.

MAJOR DIMENSIONS OF URBAN DEVELOPMENT

Urban communities are aggregates of people who interact within an environment comprised of social, economic, and physical elements. There is considerable evidence from studies conducted over the years that the interaction in communities is not random but occurs in a variety of more or less regular patterns. Indeed, much of this evidence is based on observations of the results of the human interaction so that now we expect the interaction of people, housing, and jobs, for example, will result in conditions that exhibit order and uniformity. Thus, conditions such as low income syndromes, housing quality deterioration, or socio-economic status are used in many instances to characterize the communities under study. The primary task of this study is to uncover the conditions, or traits, and their statistical bases that apply to Eastern Ontario cities and towns.

Factor analysis, which has been used here, allows us to distinguish the existence of any underlying traits of the structure of urban development in the 80 cities and towns being studied and to describe individual centers in terms of these traits. The traits emerge from the factor analysis as distinctive clusters of the original 32 variables. The clusters, because of their statistical properties, are dimensions of the urban development situations being studied. Each is made up of a linear combination of all the variables and is somewhat analogous to a linear regression equation. That is, some variables are more dominant and their "factor loadings", like regression coefficients, characterize the relationships that pertain. The factor loading is the measure of the degree of closeness between the variable and the cluster (dimension). If we know the actual scores of a

TABLE 6: Correlations Among Variables of Urban Development, Eastern Ontario, 1961.

(Decimals Omitted)

Variables		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
1.	POPULA	...																															
2.	POPCHA	06	...																														
3.	POPU15	-05	64	...																													
4.	POPO65	-21	-62	-76	...																												
5.	POPROT	-13	-12	-39	38	...																											
6.	POPRCA	12	10	38	-35	-99	...																										
7.	POPFRE	08	04	27	-20	-83	84	...																									
8.	POPENG	-09	-04	-27	20	83	-84	-99	...																								
9.	PIM45	25	48	11	-38	30	-33	-32	32	...																							
10.	UNIVER	26	21	13	-28	-13	09	08	-08	28	...																						
11.	GRAD11	33	26	-03	-29	28	-31	-33	33	57	68	...																					
12.	POPDEN	32	10	03	-34	-42	41	41	-42	10	17	17	...																				
13.	CAPINV	38	-21	-20	-07	12	12	-06	06	21	30	41	13	...																			
14.	INTASS	58	05	-09	-32	-27	26	27	-27	21	26	37	90	42	...																		
15.	UTILIT	08	-02	-06	-01	18	-23	-15	15	07	15	12	00	08	01	...																	
16.	LOCSER	43	02	-12	-24	13	-15	-11	11	36	30	50	23	52	49	18	...																
17.	INCOMM	10	02	-15	20	-06	06	-03	02	-12	18	05	-06	-07	-07	10	12	...															
18.	ININDU	-01	-08	19	-28	-07	07	01	-01	-07	01	00	-08	50	06	08	35	-39	...														
19.	INVALDU	49	27	-05	-37	04	-05	-01	01	60	36	70	46	44	65	-04	62	01	-02	...													
20.	DUSOLD	-18	-71	-49	65	20	-18	-11	11	-56	-24	-33	-34	07	-29	10	-11	-03	18	-54	...												
21.	DUFURN	35	30	-01	-29	19	-20	-13	13	45	29	63	25	39	44	07	46	-08	00	67	-41	...											
22.	DUHCWA	26	27	-05	-26	28	-29	-22	21	45	30	63	27	33	42	21	63	-04	11	65	-34	73	...										
23.	HSQUAL	25	03	-07	-19	-07	05	03	-03	21	31	49	28	22	38	10	48	18	00	49	-17	47	53	...									
24.	HSPQUA	17	-01	-13	-07	12	-04	-11	11	03	02	19	10	14	18	21	31	13	04	34	-01	26	28	21	...								
25.	NEARES	82	05	-04	-17	-18	14	08	-08	14	26	28	18	24	40	14	34	26	-09	37	-15	26	17	27	19	...							
26.	NMETTO	-26	05	12	-06	12	-15	-32	32	-04	04	-07	-28	20	-35	06	-08	30	-09	-37	06	-31	-22	-16	-15	-07	...						
27.	HIGHWA	50	-04	-22	-17	-07	05	-01	01	24	20	35	57	32	68	03	61	22	-09	55	-19	31	41	44	33	39	-08	...					
28.	EMPMAN	-10	-20	-04	-12	19	-18	-18	18	14	-22	-07	-13	33	-02	-03	26	-42	64	03	19	-07	02	-07	-04	-19	-03	-08	...				
29.	EMPSER	04	33	10	-13	-20	19	05	-05	20	30	20	20	-17	11	-06	-03	49	-54	17	-31	07	03	15	16	18	21	22	-55	...			
30.	FAMERN	42	35	17	-53	03	-06	-03	03	55	59	80	31	42	48	10	58	-10	13	77	-53	65	70	46	24	35	-18	41	03	11	...		
31.	EMPSEX	-23	27	41	-16	-10	09	03	-03	-09	07	-19	-25	-02	-33	09	-37	-08	19	-43	00	-17	-25	-27	-30	-20	31	-43	-01	-06	-21	...	
32.	LEVRET	98	06	-08	-22	-14	12	08	-08	24	26	35	34	37	61	10	52	14	01	54	-18	37	32	33	25	83	-24	57	-07	04	45	-29	...

center on all the variables, then through the factor loadings the center can be related to all other centers relative to any of the dimensions.

Each community possesses each of the dimensions of urban development to some degree, just as each person possesses some degree of all human personality traits. Indeed, differences between centers are explained by the different configurations of dimensions that occur together in each place. The dimensions may, therefore, be viewed in two ways: either as explaining the interaction of people, events, and physical environment in urban centers, or as the outcome of the interaction that has occurred in the center in the past.

A total of ten dimensions were extracted in the analysis of the intercorrelation of 32 variables. However, only seven were considered either meaningful or statistically reliable. Table 7 presents the content of each dimension in terms of the factor loadings of each variable. The largest loadings, either positive or negative numbers, suggest the meanings of the dimensions. Positive loadings indicate the variable increases in importance as the dimension becomes more prominent in describing an urban development situation. Negative loadings indicate an increase in importance for the variable as the dimension decreases. The dimensions may then be named according to the meaning suggested by those variables which are most prominent in each cluster.

The seven diemsions have been labelled as follows:

1. PHYSICAL DEVELOPMENT
2. FRENCH/ENGLISH
3. POPULATION AGE
4. INDUSTRIAL/COMMERCIAL DEVELOPMENT
5. POPULATION SIZE
6. EDUCATION LEVEL
7. COMPACT DEVELOPMENT

The names have been chosen to be as descriptive as possible while also being as neutral as possible. The names cannot be considered binding because, of course, extant community relationships must be able to be matched against the labels. Or, putting it another way, the labels tend to describe development in those communities which fall to the extremes of the dimensions. In the dimension Education Level, for example, a community may be identified as one with a high education level or a low education level. Whether this is a valid label for a center must be confirmed by evidence. It is important to grasp the fact that these dimensions are not just single variables describing a situation but are clusters of variables which say, in effect, each of several variables in a cluster must be considered to reflect the situation.

In statistical terms the ten dimensions accounted for over 85 per cent of the variance present in the data for the original 32 variables. (The seven selected dimensions accounted for 75 per cent.) Moreover, only six of the variables have less than 80 per cent of their variance explained, and none have less than 70 per cent variance explained (Table 8).

The content and meaning of the seven dimensions of urban development in Eastern Ontario are discussed below. In order to facilitate understanding of them the reader may find it useful to think of communities that fit the descriptions offered. Or, in other words, to ask of each of the dimensions: "Do I know of cities and towns in Eastern Ontario like this?"

Dimension 1: Physical Development (V1). This dimension has significant loadings on several variables of housing quality as well as on high school quality, educational attainment, and local services level. It characterizes by high scores urban centers with good housing, good schools, good local services and reasonably high levels of family income. Communities without these qualities would score low.

Dimension 2: French/English (V2). This dimension distinguishes urban centers on the basis of the predominance of either the French or English Language being spoken by the inhabitants. Combined with the segregation of French and English language communities is the presence of predominantly Roman Catholic church affiliations in the former and Protestant church affiliations in the latter. An additional facet of these communities shows that French speaking places have received little new immigration from abroad since 1945.

Dimension 3: Population Age (V3). This dimension indicates that urban centers whose population contains a large proportion of persons over 65 years of age will be found not to contain many persons under 15 years of age. Communities with old populations will also have experienced much smaller population growth rates in the immediate past. While communities with young populations will contain a large proportion of dwellings built since 1945 and the average annual family earnings will also be higher.

Dimension 4: Industrial/Commercial Development (V4). This is a polar dimension indicating that communities with a high degree of industrial development tend not to have a high degree of commercial development, and vice versa. This is true with regard both to the proportion of labour force employed in each sector and to the proportion of total capital investment (assessed valuation) in commercial or indus-

TABLE 7: Dimensions of the Structure of Urban Development, Eastern Ontario, 1961

VARIABLE No.	Name	VARIMAX FACTOR V_1	V_2	V_3	V_4	V_5	V_6	V_7	V_8	V_9	V_{10}
		(Decimals Omitted)									
1	POPULA	10	04	06	00	94*	14	-12	01	-21	01
2	POPCHA	04	-01	88*	-20	01	06	-03	04	06	00
3	POPU15	-12	33	80*	13	-06	-01	11	09	20	-05
4	POPO65	-12	-24	-84*	-25	-10	-12	-11	-04	18	-06
5	POPROT	09	-93*	-18	04	-09	00	-10	06	11	-05
6	POPRCA	-09	94*	15	-03	07	-03	08	-10	-10	03
7	POPFRE	-01	93*	03	-05	02	-02	-17	-03	-09	-08
8	POPENG	01	-93*	-03	05	-02	02	17	03	10	08
9	PIM45	20	-48*	54*	-01	15	24	-11	-16	-20	-04
10	UNIVER	21	11	16	-15	12	83*	12	10	-03	-07
11	GRAD11	46*	-35	24	-07	17	66*	-09	-03	-14	04
12	POPDEN	14	35	13	-09	08	05	-14	06	-87*	-01
13	CAPINV	12	-08	-19	49*	28	60*	-09	-03	-20	12
14	INTASS	24	20	06	06	35	19	-18	01	-81*	03
15	UTILIT	10	-16	-04	00	08	04	04	89*	-03	12
16	LOCSER	63*	-13	03	35	32	20	16	01	-27	22
17	INCOMM	20	06	-17	-52*	19	07	56*	01	10	16
18	ININDU	03	12	04	90*	-03	16	02	12	08	10
19	MVALDU	51*	-12	29	-01	31	32	-28	-24	-39	22
20	DUSOLD	-18	-03	-81*	22	-08	07	10	14	21	03
21	DUFURN	52*	-21	28	-04	19	32	-41*	05	-13	10
22	DUHCWA	69*	-28	24	05	08	22	-23	18	-21	11
23	HSQUAL	83*	10	01	-05	12	16	06	06	-10	-01
24	HSPQUA	17	-05	-01	-03	11	01	-07	12	-08	-93*
25	NEARES	13	09	04	-13	90*	11	07	05	-03	06
26	NMETTD	-16	-23	11	-05	-13	00	82*	08	09	-13
27	HIGHWA	39	-03	-05	-05	36	05	20	-08	-67*	20
28	EMPMAN	02	-19	-03	85*	-08	-10	02	-16	-04	-01
29	EMPSER	-01	08	22	-69*	-01	24	32	-14	-17	25
30	FAMERN	50*	-09	43*	09	24	51*	-18	-02	-19	10
31	EMPSEX	-47*	09	28	12	-17	24	17	36	29	-27
32	LEVRET	20	05	05	02	92*	10	-07	02	-24	08
Sum of Squares		334	451	383	289	338	237	176	119	287	129
% Variance (10 Factors		12.2	16.5	14.1	10.6	12.4	8.7	6.5	4.4	9.9	4.7

* Factor loadings of at least .40 are most significant.

TABLE 8: Variance Accounted for in Basic Variables (Communality)

VARIABLE No.	Name	Percent 1/
1	POPULA	96.7
2	POPCHA	82.2
3	POPU15	84.7
4	POPO65	90.6
5	POPROT	93.9
6	POPRCA	94.5
7	POPFRE	91.5
8	POPENG	91.7
9	PIM45	72.0
10	UNIVER	82.6
11	GRAD11	87.8
12	POPDEN	94.9
13	CAPINV	79.2
14	INTASS	94.9
15	UTILIT	85.3
16	LOCSER	82.5
17	INCOMM	73.3
18	ININDU	88.1
19	MVALDU	89.4
20	DUSOLD	81.5
21	DUFURN	72.5
22	DUHCWA	81.6
23	HSQUAL	76.0
24	HSPQUA	93.3
25	NEARES	87.2
26	NMETTD	82.0
27	HIGHWA	81.6
28	EMPMAN	80.0
29	EMPSER	80.5
30	FAMERN	84.5
31	EMPSEX	71.6
32	LEVRET	96.7

1/ Communality over 10 factors.

trial buildings. Further, industrially oriented communities have generally higher levels of capital investment per capita and provide better local services.

Dimension 5: Population Size (V5). Communities with large populations and a large number of retail and commercial establishments receive the highest scores on this dimension. They would also be found not located very near a competing center, thus explaining their apparent dominance in population and retail services. Such large centers also have generally better highway access, higher intensity of capital investment per acre, and higher value dwelling units.

Dimension 6: Education Level (V6). The educational attainment of the adult population is the strongest distinguishing characteristic on this dimension. That is, where the adult population have obtained grade 11 or better education the urban center will score high. Also associated with better educated urban adult populations are higher levels of family earnings and a higher per capita investment in land and buildings.

Dimension 7: Compact Development (V7). This dimension distinguishes communities on the basis of their density of population and their intensity of capital investment in land and buildings. The more compact the community the more likely it is to have good highway access. (Due to the computation method, compact centers will have high negative scores on this dimension.)

Several points need to be made about the results of the factor analysis. The first of these is that the dimensions themselves are neutral indicators of existing conditions. They reflect the outcome of how the population in Eastern Ontario cities and towns responded to their social, economic and physical environment. The statistical format of each dimension allows us to recognize the various items that interact in the particular development situation of this region. We know, for example, that the achievement of a high level of "physical development" is associated with good housing, high schools, and public services. We also know that centers with young populations are distinct from those with old populations; that French-speaking centers are distinct from English-speaking centers; and that industrial centers are not likely also to be prominent commercial centers.

A second point of importance is that the factor analysis has defined seven dimensions to describe the structure of urban development in the region's incorporated centers. In other words, the analysis shows that any single center cannot be adequately described without using these seven dimensions, even though other means of description may also be deemed necessary. The high degree to which the dimensions contribute to a statistical explanation of the centers indicates that they are fundamental to our understanding of urban development in the region. The seven dimensions fall generally into three categories: Physical Development, Population Size, and Compact Development provide descriptions of physical attributes; French/English, Population Age, and Education Level describe social attributes of centers; and Industrial/Commercial Development describes economic base characteristics.

A third facet of the analysis shows the independence of various conditions of urban development among the region's centers. The dimensions are, according to the mathematical rationale behind the analysis, statistically independent of one another. That is, the presence of one condition of development, as reflected by a particularly high score on a dimension, does not require the presence of any other condition to any significant degree. If it were the case in Eastern Ontario centers that a high level of physical development was always present with a large population size, compact development, and high educational attainment, then there would have been generated in the analysis a single large dimension. But seven separate dimensions were generated. Thus, an urban center with a high level of physical development need not be expected also to show a high incidence of young people in the population. There is an equal chance that the opposite might be true. This is an important result of the factor analysis because it warns us not to expect all the signs of possible growth or decline to be localized among a few centers. Urban centers in the region will possess not only different degrees of the conditions of "physical development," "education level," "industrialization," etc., but also different combinations of the conditions.

In summary, the factor analysis has indicated that there are seven dimensions underlying urban development throughout the region. None of the associations evident in the various dimensions is particularly surprising. That housing quality, local services, high school quality, and family earnings are found together (Dimension 1) is understandable. And so are the associations of population size and retail services (Dimension 5), of educational attainment and family earnings (Dimension 6), and of population and investment density (Dimension 7). But it is somewhat surprising to find that all these facets of urban development do not congregate on a single dimension. This means that some communities may be strong on any one of these four dimensions but not necessarily on any of the others. The remaining three dimensions, French/English (2), Population Age (3), and Industrial/Commercial (4) are all polar dimensions which indicate substantial numbers of centers in the

region fit conditions at either extreme of each dimension. This segregation of old and young, of industrial and commercial development, and of French-speaking and English-speaking, if not surprising, must not be ignored. It represents an important fact of urban development in the region. Indeed, it is not the purpose of a factor analysis to test one's credulity; it ought to produce plausible results. However, since the basic premise of this kind of analysis is that there are common relationships within clusters of variables, the results must be approached with assumption that it is the clustering of variables that is important to grasp. If this can be done, a new and more realistic level of understanding can be obtained regarding urban development.

THE GEOGRAPHY OF URBAN STRUCTURE

All the cities and towns of Eastern Ontario can be arrayed on maps which portray each of the structural dimensions of urban development. Each center can be assigned a numerical score on the basis of its original scores on each variable and the appropriate factor loadings. These canonical variates, as they are called, can be obtained for dimension 1 by multiplying a center's population size by factor loading 0.097, plus the center's rate of population change by factor loading 0.039, and so on through all 32 variables. The same procedure is followed to obtain scores on the remaining dimensions. The scores are then mapped. For this study the scores are grouped by quintiles to facilitate viewing on the maps. Scores on all dimensions range from negative to positive, with the average of all scores being equal to zero.

Figures 5 through 11 contain the geographical distributions of scores for the seven dimensions. It will be useful to provide a somewhat impressionistic view of each map in order to indicate to what degree the conditions of urban development are located in one or a few areas of the region, or whether they are relatively dispersed.

Physical Development among the region's incorporated centers is shown in Figure 5. All the largest centers fall into the top two quintiles on this dimension as do most of the centers along the St. Lawrence Seaway and Lake Ontario. Three noticeable areas where centers are in the lowest three quintiles are the easterly four counties of the region (Russell, Glengarry, Prescott, Stormont), in the Canadian Shield area of the Lake Ontario Development Region, and in the upper Ottawa Valley.

French/English differences in the region's centers are shown in Figure 6. Centers show the greatest degree of regionalization on this dimension. French-Catholic communities are concentrated in the eastern counties and along the Ottawa Valley. English-Protestant communities are found in the remainder of the region, but are particularly dominant in the western counties.

Population Age distinctions among centers are indicated in Figure 7. Most large centers and centers along the Seaway and Lake Ontario fall into the top two quintiles which delimit generally young populations (Ottawa, Peterborough, Brockville, Cobourg). Communities in the Canadian Shield area and through most of the interior of the eastern counties are dominantly populated by persons in older age groups (Omemee, Hastings, Chesterville, Newboro). Prince Edward County, on Lake Ontario, also falls into the latter category.

Industrial/Commercial Development patterns among centers are shown in Figure 8. Industrial development characterizes many centers along the Seaway and Lake Ontario and certain other resource base communities (Prescott, Ganonoque, Port Hope). Commercial development predominates in most inlying centers serving agricultural and resort areas, as well as large urban centers (Kemptville, Westport, Tweed, Bancroft).

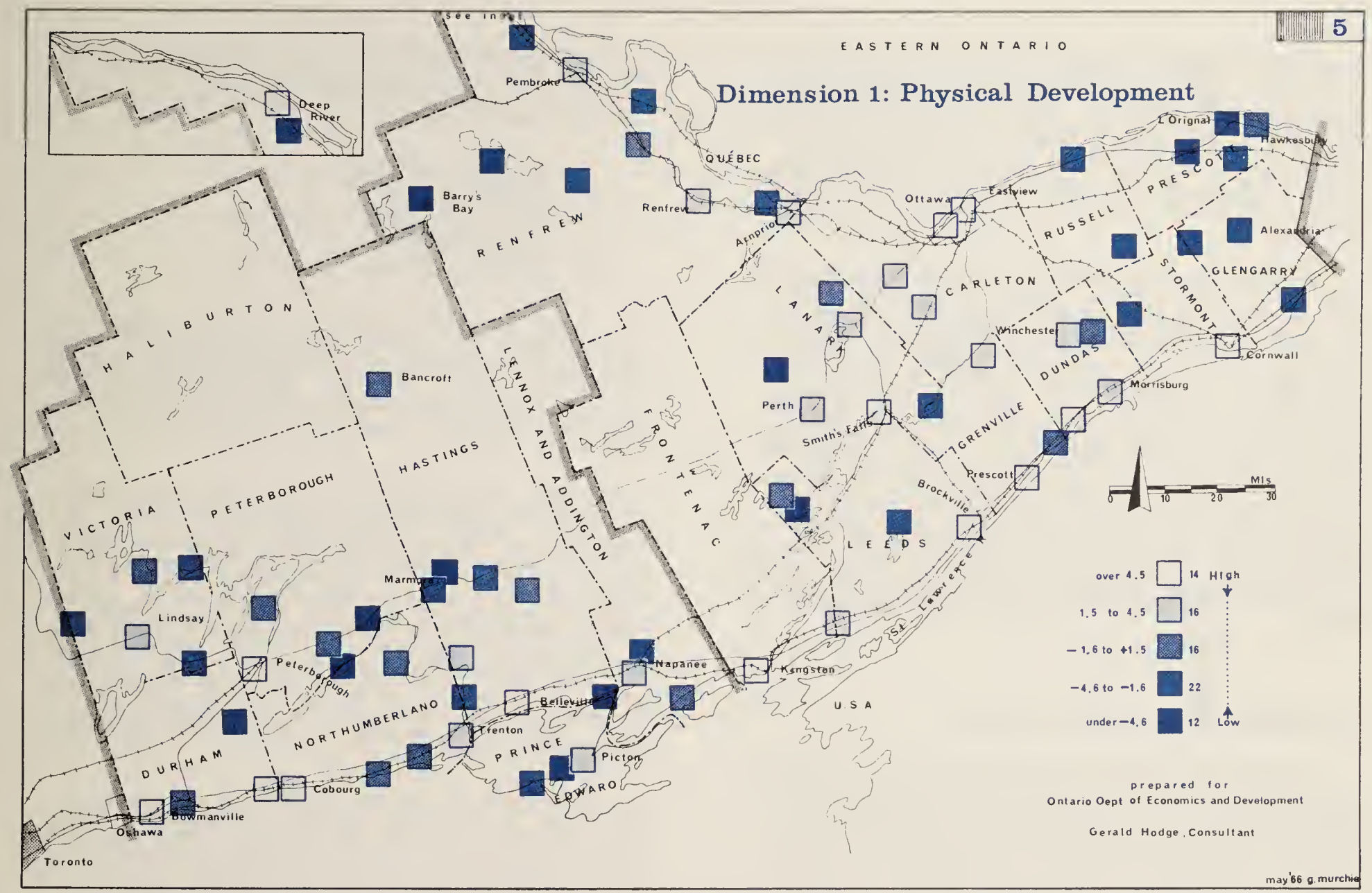
Population Size differences as we normally conceive them are preserved in this dimension as shown in Figure 9. Places like Ottawa, Kingston, Peterborough, and Brockville all rank toward the top of the scale. Whereas places like Marmora, Barry's Bay, and Finch have scores indicating a small population size and retail services level.

Education Level throughout the region is shown in Figure 10. Communities in the easternmost counties, generally, considered to be "depressed", evidence low education levels. Also in this position are centers in the Canadian Shield area of the western counties (Alfred, Newboro, Hastings, Woodville). Large and economically prosperous centers have high scores on this dimension (Trenton, Napanee, Lindsay).

Compact Development differences among the region's centers appear in Figure 11. Densely populated and built-up centers are the largest centers as well as most places located on the Seaway or Lake Ontario (Kingston, Cornwall, Smith's Falls, Bowmanville). Canadian Shield centers in the easternmost counties show low levels of compactness (Deloro, Bobcaygeon, Maxville, Casselman).

EASTERN ONTARIO

Dimension 1: Physical Development



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The factor analysis method employed here, by definition, develops dimensions that are statistically independent of one another which means that the scores on the seven maps need not be similarly distributed. Most centers will not, therefore, be found to fall always at the same position on the different dimensions, although for a small number of centers this is possible within the limits of the analysis. This means that there may be considerably different combinations of conditions comprising the picture of urban development for different centers, even for centers in the same locale.

The large urban centers of the regions, Ottawa, Kingston, Cornwall, Peterborough, Belleville, etc., tend to fall into those quintiles which suggest favorable condition on the following dimensions: Physical Development, Population Age, Compact Development and Education Level. It should be noted that some of these centers are strongly "industrial" while others are just as strongly "commercial" thereby indicating that divergent economic bases can be associated with satisfactory development in other respects. Insofar as there is a convergence of conditions denoting possibly unfavorable urban development emerging from the maps it may lie in the coincidence of low scores on the dimensions of Physical Development and Compact Development in the Counties of Russell, Stormont, Glengarry, and Prescott in the east and the Counties of Victoria, Peterborough and Hastings in the west. Most centers in these counties also generally possess "young" populations, "low" levels of education among their residents, and have "small" numbers of population. If these conditions are construed to be unfavorable, it could be said that the counties mentioned are multiple problem areas.

SUB-REGIONAL MEASURES OF URBAN STRUCTURE

Separate analyses were carried out for the two Development Regions which the Ontario Government has designated in Eastern Ontario. For the Lake Ontario Development Region, covering eight counties in the west, and the Eastern Ontario Development Region, covering eleven counties in the east, individual factor analyses were performed using the same 32 variables employed for the study of the entire region. In this way, it is possible to determine whether there are significant and relevant differences in the urban structure of each region. Since, indeed, only minor differences were observable between the two sub-regions, only the main features of each analysis are presented here.

Lake Ontario Sub-region. The 34 incorporated cities and towns of this region were subjected to a principal components factor analysis utilizing 32 variables (see Table 5). Again, seven factors, or dimensions, were extracted. They were named as follows:

1. PHYSICAL DEVELOPMENT
2. RELIGIOUS AFFILIATION
3. MIGRANT DESTINATION
4. INDUSTRIAL/COMMERCIAL DEVELOPMENT
5. POPULATION SIZE
6. EDUCATION LEVEL
7. COMMERCIAL DOMINANCE

Several dimensions uncovered for the urban structure of this sub-region are identical with dimensions found for the entire region: Physical Development, Industrial/Commercial Development and Education Level. The Population Size dimension in this area combines the attributes of "compactness" that were found to be independent when all centers in the region were considered. Otherwise, Population Size is a similar dimension.

Another dimension that was slightly transformed concerns language orientation and religious affiliation. In this western sub-region, where the french language is much less used, the religious affiliation of people in urban centers is more prominent in distinguishing communities. Moreover, this dimension also combines the population age factor previously deemed an independent dimension. In this area, the predominantly Protestant and English communities have greater proportions of population over 65 years of age. The predominantly Roman Catholic and French communities have much larger proportions of persons under 15 years of age. The latter centers also have such attributes as high levels of university training in some segments of the population, greater industrial development, a rapidly expanding population. Peterborough, Cobourg, Deloro, Belleville, and Trenton display these attributes.

Two quite new dimensions emerge to describe the urban development in this region: Migrant Destination and Commercial Dominance. The first is named because of the strong factor loading on the variable measuring the proportion of people in the population of a center who have emigrated to Canada from abroad since 1945. These centers that have been the destination of many immigrants also show evidence of having low proportions of their dwelling units built before 1945, high median value in their housing stock, fairly high family earnings, a large french-speaking segment of the population, and of having sustained a rapid increase in population in the 1951-1961 decade. Bowmanville, Newcastle, Port Hope, and Bath are revealed as of this character as

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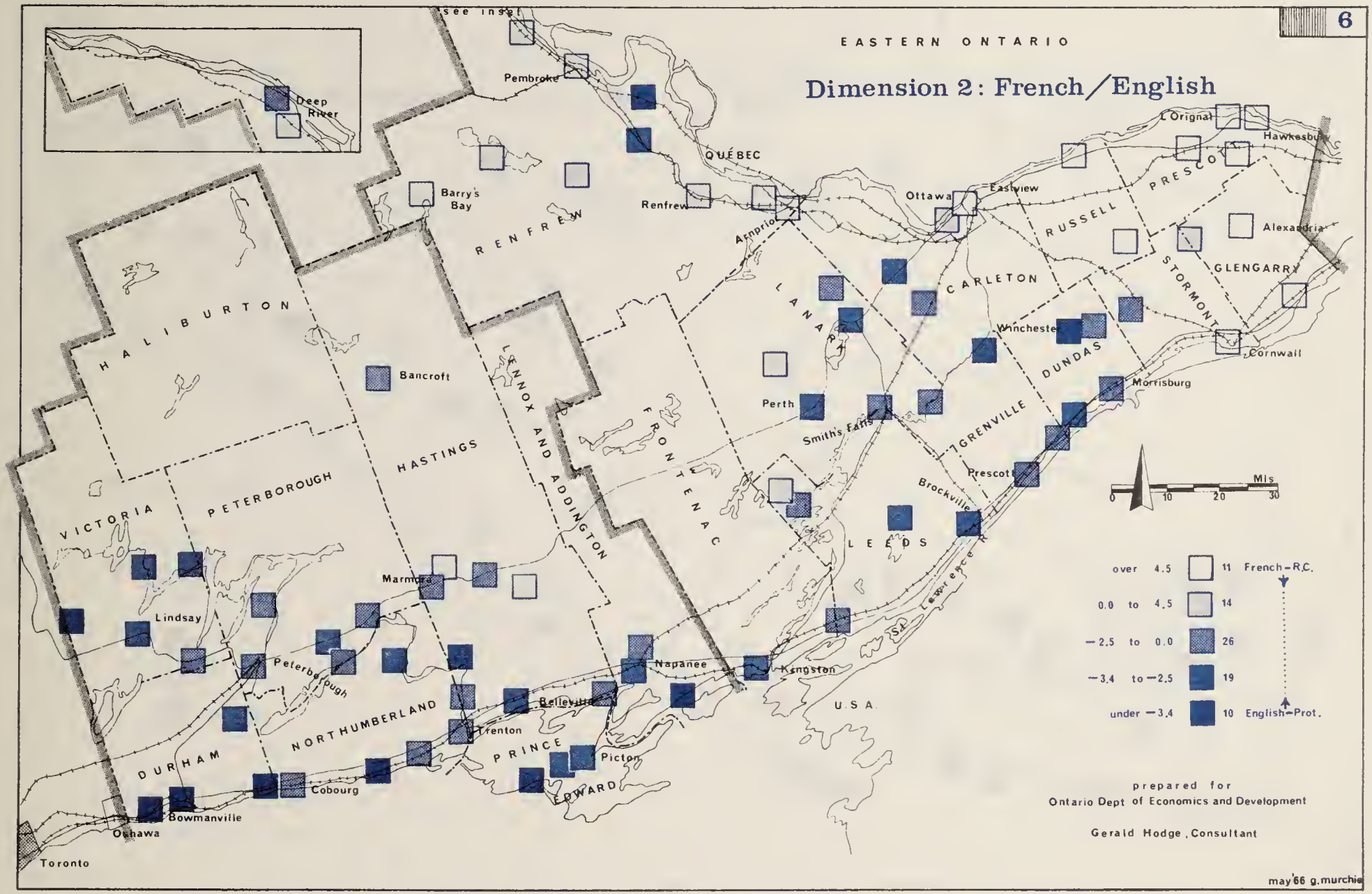
Dimension 2: French/English



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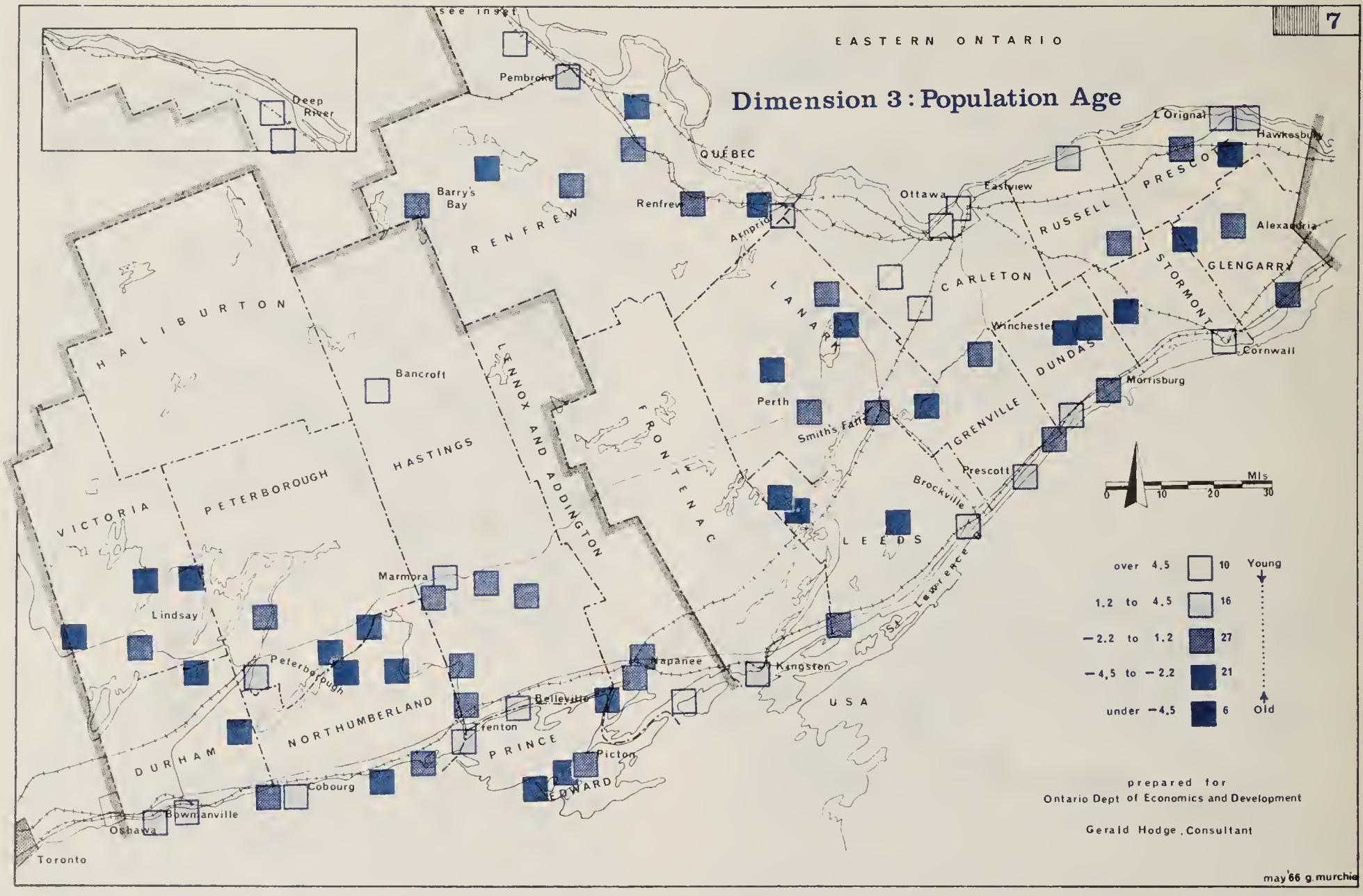
Dimension 3 : Population Age



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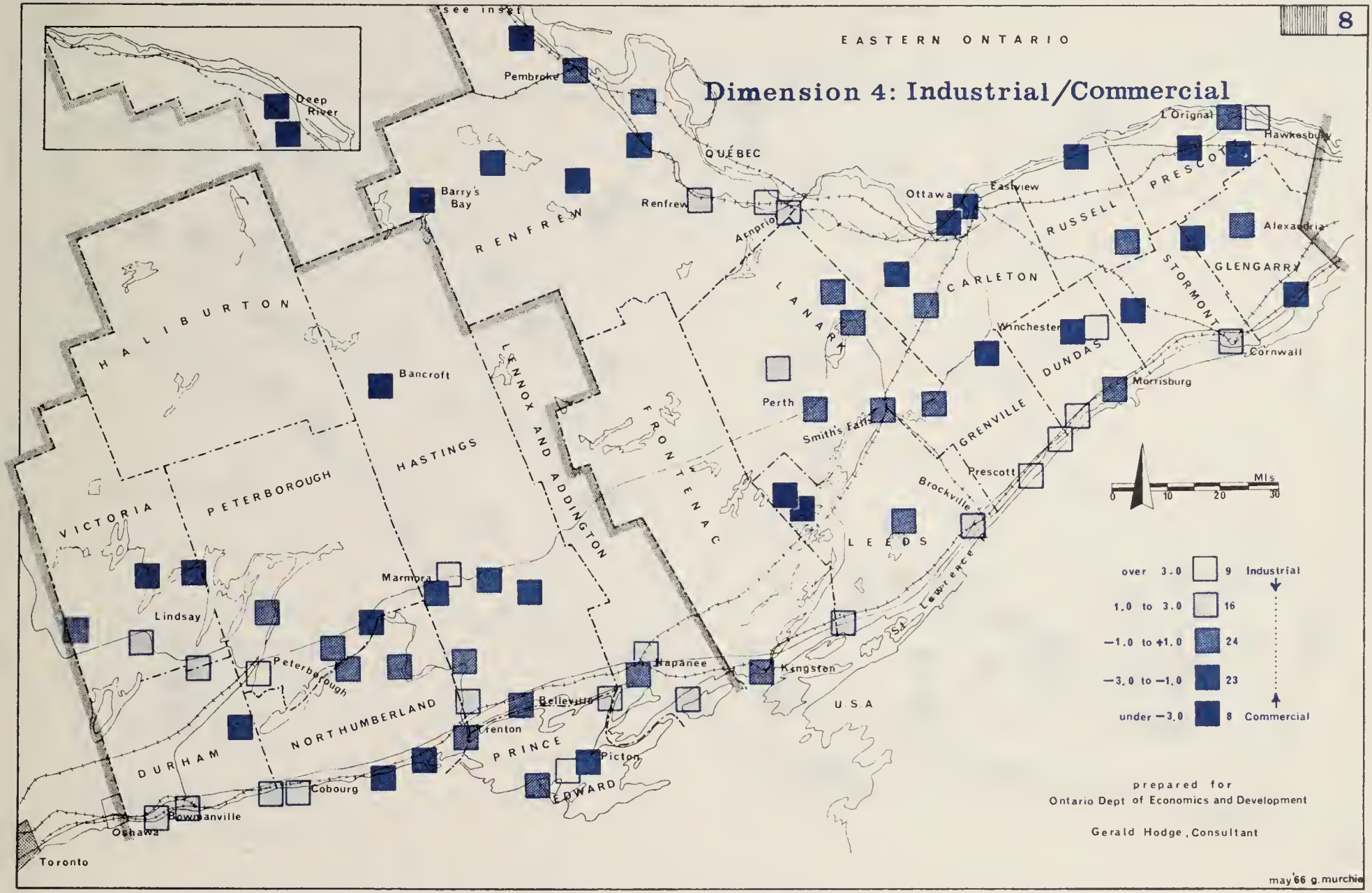
Dimension 4: Industrial/Commercial



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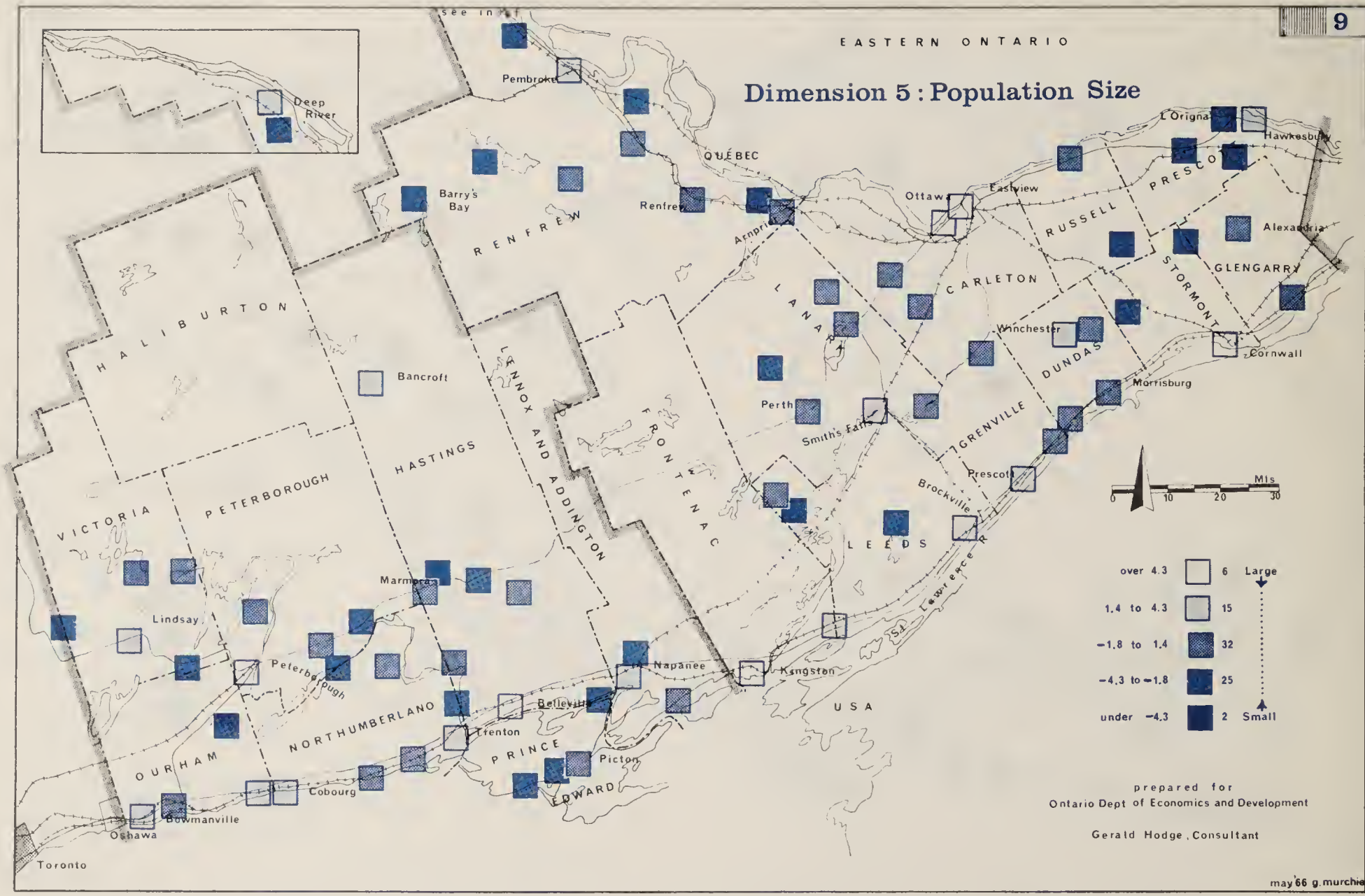
Dimension 5 : Population Size



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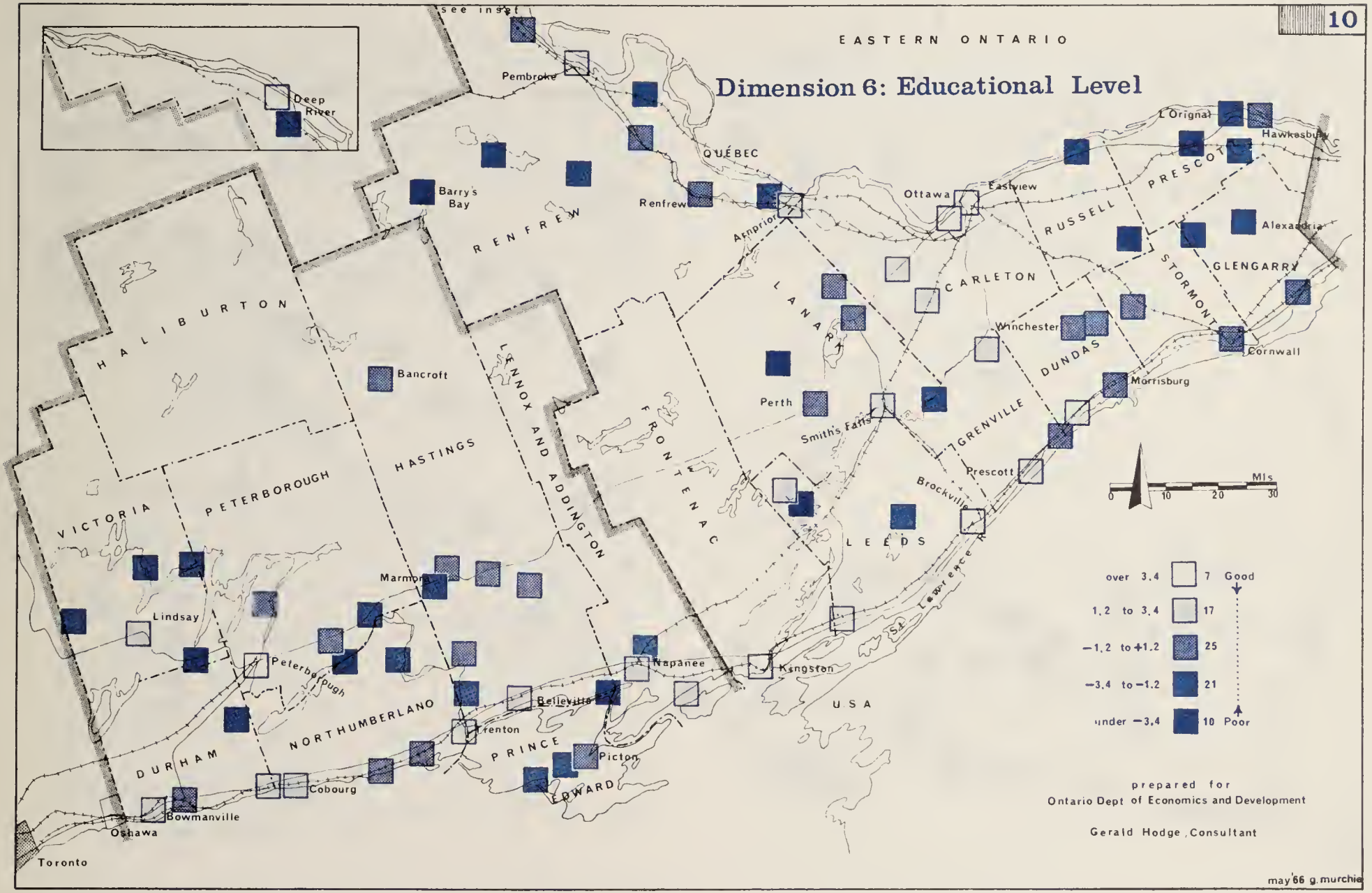
Dimension 6: Educational Level



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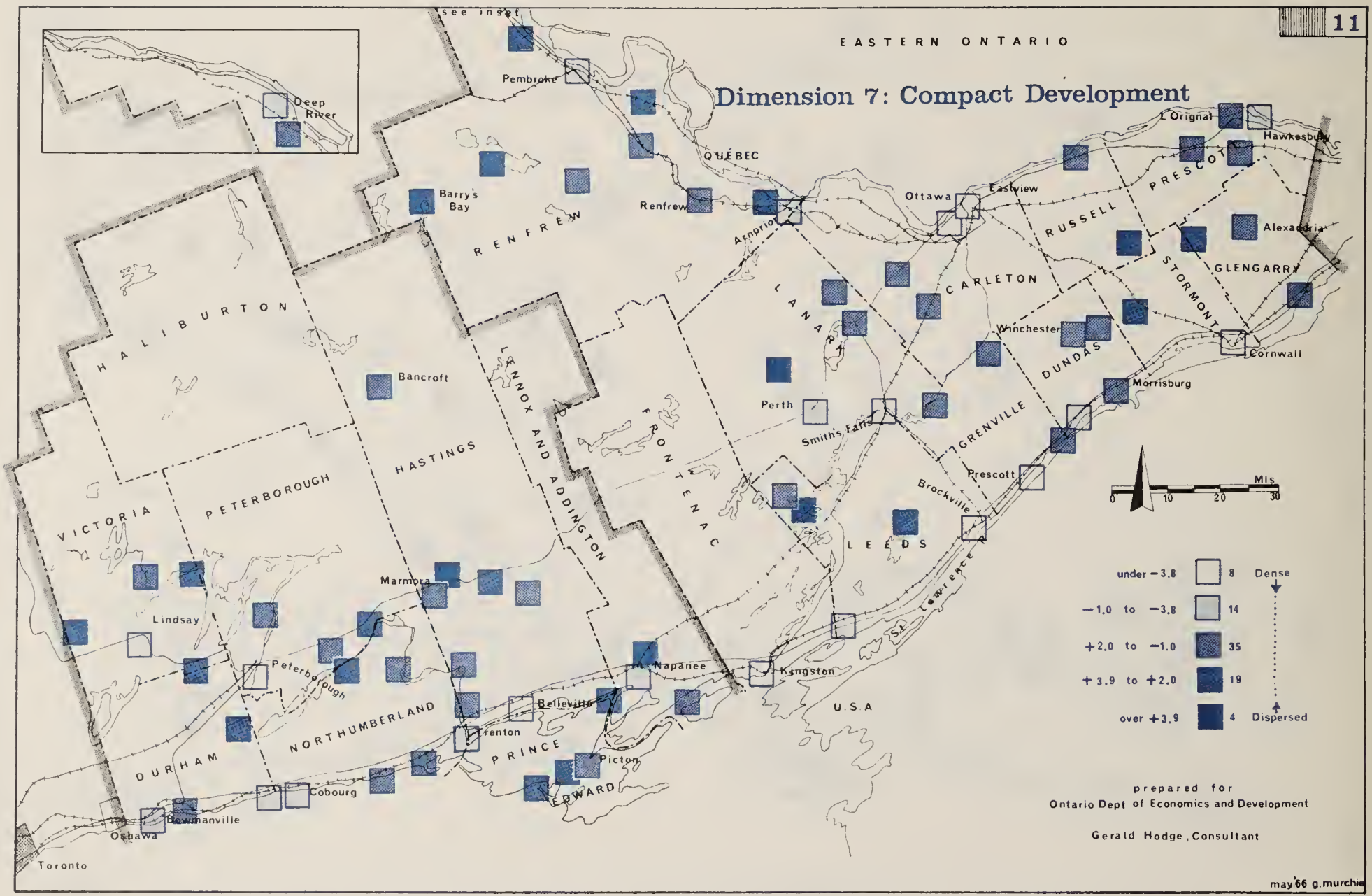
Dimension 7: Compact Development



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well as the largest centers of the sub-region. The Commercial Dominance dimension distinguishes centers not by the size of their commercial base but by their degree of separation from competing centers of the same or higher rank. Such centers tend not to be near a metropolitan center, to have increased their population rapidly in the past decade, and to have a large french-speaking segment. Bancroft, Picton, Tweed, and Peterborough are the most prominent examples of centers ranking high on the Commercial Dominance dimension.

Eastern Ontario Development Region. A total of 46 incorporated centers are found in this sub-region. The factor analysis, again using 32 variables, extracted seven meaningful dimensions which were named as follows:

1. PHYSICAL DEVELOPMENT
2. FRENCH/ENGLISH
3. POPULATION AGE
4. INDUSTRIAL/COMMERCIAL DEVELOPMENT
5. POPULATION SIZE
6. SPECIAL FUNCTION
7. COMPACT DEVELOPMENT

With only two significant differences do these dimensions vary from those extracted for the entire study region. One difference is that the dimension of Physical Development, while maintaining the same variables as previously, also adds the variables dealing with educational attainment of the adult population in this region. In other words, the better the physical development of a center in this sub-region the more likely it is that the adult population of the center will have attained higher education levels. In the Lake Ontario sub-region, by contrast, a well educated population did not necessarily live in the centers with the best physical development. The second important difference is the emergence of a dimension distinguishing centers which, while not at great distances from the metropolitan center of Ottawa, show a high degree of commercial investment and employment in service occupations. Barry's Bay, Deep River, Petawawa, and Lancaster are centers with high scores on this dimension. This dimension, clearly, has distinguished centers performing special functions such as housing national defence, or government research establishments or acting as tourist and recreation centers.

In summary, the separate analyses of the centers in the two sub-regions show that there are certain common structural features of urban development present in both areas. The dimensions of Physical Development, Education Level, Industrial/Commercial Development, Compact Development, and Population Size recur in both analyses. They are either replicated almost completely in each sub-region or are changed only moderately. Several new dimensions emerged in each sub-region thus reflecting the unique conditions of the areas and their centers. The Eastern Ontario sub-region, for example, has substantial clusters of french and english speaking populations which is not the case in the Lake Ontario sub-region. The latter sub-region has, on the other hand, more industrial development and has, therefore, attracted more population from among recent Canadian immigrants. The large number of centers performing specialized activities in the Eastern Ontario sub-region brings forth a new dimension to cover that kind of structural condition among the centers. Whether any of the new or common dimensions are associated with performance of centers in the respective sub-regions is discussed in a later section.

PART FOUR

URBAN STRUCTURE AND URBAN GROWTH

The analyses described above point up the complex relations among social, economic, and physical characteristics that underly urban development in the centers of Eastern Ontario. These complex relations have been refined into seven dimensions of urban development which may now be used to describe the region's centers rather than a large number of individual measures. This is, however, a description of the present situation, and beyond knowing what is there now it would be useful to know how present conditions of urban development reflect performance of centers. The structure of urban development observed in a center is the outcome of interaction in the past of people, jobs, houses, etc. as well as being the prevailing picture of development. Thus, we may perform further tests on the centers to determine whether those aspects of urban structure which have been uncovered in the factor analysis have a significant bearing on the possibilities for growth or decline among centers.

Three variables of past performance were tested to find out how they were associated with the seven dimensions of urban development. The performance variables were (1) the Rate of Change of Population from 1951-1961; (2) the Rate of Change in the Number of Retail Firms from 1951-1961; and (3) the Rate of Change in Assessed Valuation from 1956-1963. These measures of performance for each center were examined in a multiple regression analysis against the scores of each center on each of the seven dimensions. In this way, it is possible to determine whether any of the three aspects of growth is associated with particular dimensions and to what degree (see Table 9).

It must be noted that the regression analyses aimed at explaining the rate of change and not absolute change. Percentage rates of change were computed for each center on the three variables. Where the rate of change was positive (indicating an increase) it was added to a basic score of 100; where the rate of change was negative (indicating a decline) it was subtracted from 100. Hence, scores of less than 100 indicate overall decline in the period; scores equal to 100 indicate no change during the period; and scores exceeding 100 indicate overall growth. The analysis will, thus, explain why population, or the number of retail firms, or the assessed valuation grew or declined at a fast or slow rate.

An additional regression analysis was carried out to determine the relationship between the structure of urban development and some measure of the level of economic development. The measure of Average Family Earnings for 1961 as reported by the Census of Canada was used for this purpose. The result of this regression test is reported first.

URBAN STRUCTURE AND FAMILY INCOME

The average level of family earnings among the 80 incorporated centers of Eastern Ontario in 1961 was $4,322 per annum. The center with the highest average family earnings was Deep River and the lowest average was in Newboro. When these various scores were regressed against the seven dimensions of urban development previously derived in the factor analysis, a high degree of association was found present. Nearly 84 per cent of the variation in the level of family income was explained by the seven dimensions (see Table 10). Three dimensions in particular contribute to this high level of explanation. In order of importance they are: Education Level, Population Age, and Physical Development. This relationship, stated in non-mathematical terms, is that an urban center could be expected to have a high level of family income when its adult population is well educated, its general age of population is young, and when its level of physical development is high. This relationship is not surprising since better educated individuals can normally command higher paying jobs, a young population will have more family members employed and have fewer people on retirement incomes or pensions, and a better quality of physical environment is one of the more important attributes that higher income families strive for. It may be more important to note that none of the remaining four dimensions contribute significantly to the explanation of family earnings levels. That is, income levels for families apparently have little to do with French/English differences, population size, the degree of industrialization, or the compactness of urban development in Eastern Ontario centers.

The regression equation made good estimates, within 10 per cent of the 1961 figure, for 71 of the 80 incorporated centers in the region. Those centers for which good estimates were not obtained may be of interest. Family incomes were estimated too low for Almonte, Cardinal, Casselman, Chalk River, Havelock, and Woodville. Estimates were too high for Deloro, Newboro, and Petawawa. Except in these few cases, urban development is, clearly, very closely associated with this facet of economic development.

TABLE 9: Variables Used in Performance Analyses of Urban Centers, Eastern Ontario, 1961

Y_1, Rate of Change in Population, 1951-1961.

Y_2, Rate of Change in Number of Retail and Commercial Establishments, 1951-1961.

Y_3, Rate of Change in Assessed Valuation, 1958-1963.

Y_4, Average Family Earnings, 1961.

X_1, Factor Scores for Centers on V_1, "Physical Development".

X_2, Factor Scores for Centers on V_2, "French/English".

X_3, Factor Scores for Centers on V_3, "Population Age".

X_4, Factor Scores for Centers on V_4, "Industrial/Commercial".

X_5, Factor Scores for Centers on V_5, "Population Size".

X_6, Factor Scores for Centers on V_6, "Education Level".

X_7, Factor Scores for Centers on V_9, "Compact Development".

b_0, The Intercept of Y at X=0.

b_j, Amount to be Added to an Estimate of Y_i if the Center has a Value of X_j=1.

TABLE 10: Results of Regression of Urban Development Dimensions on Average Family Earnings, 1961, Eastern Ontario

Independent Variables	Regression Y_4 Average Family Earnings b_j	t Value
V_1, "Physical Devel."	72.78013	2.72879**
V_2, "French/English"	7.93120	.72697
V_3, "Population Age"	40.75531	3.42015**
V_4, "Industrial/Commercial"	23.59134	1.98386
V_5, "Population Size"	-15.11094	-0.86208
V_6, "Education Level"	100.77369	3.80481***
V_9, "Compact Devel."	28.04547	1.08780
R^2, Coefficient of Determination	0.8358	
b_o, A Intercept	4322.246	
F Value	34.0045**	

*** Significant at 1/10 of 1% level.

** Significant at 1% level.

* Significant at 5% level.

(The variable Average Family Earnings is prominent in the clusters comprising each of the three dimensions. This will not significantly affect the regression test results, however, because of the relatively small proportion of total variance contributed by this variable to the total factor matrix (less than 0.3 per cent) or to any of the three clusters (less than 8 per cent on V1, less than 5 per cent on V3, and just 10 per cent on V6). If this variable were omitted from the factor matrix before regression, overall explanation, R^2, would be reduced only slightly according to tests that have been made in this study. Thus, rather than produce another factor matrix and possibly confuse the picture on urban structure, the original matrix has been used. It has been judged that the essence of all relationships is still preserved in these results.)

URBAN STRUCTURE AND POPULATION GROWTH

Population rates of change in the region's incorporated centers averaged just over 32 per cent growth in the 1951-1961 decade. Only six centers showed any absolute decline in numbers, the lowest of which was Deloro with an almost 36 per cent drop. An additional 19 centers had less than a 10 per cent increase in numbers. Petawawa, Deep River, Cornwall, and Stittsville experienced a doubling of population at least in the period. The regression analysis was able to explain slightly over 80 per cent of the variance in rates of population change in terms of the positions of centers on the seven dimensions (see Table 11). Three dimensions account for most of the explanation: Population Age, Industrial/Commercial Development, and Education Level. The French/English dimension contributes a small, but still significant portion of the explanation.

The relationship which emerges may be stated as follows:

an urban center can be expected to experience a faster rate of population growth when its population is relatively young, when its economic base is devoted to commerce rather than industry, and when the adult education level is not high.

Non-french speaking communities with these traits are more likely to experience rapid population growth than French speaking communities, with the same traits. Or looked at another way, in centers with similar levels of education among the adult residents the rate of population growth would be faster where the population was younger, the amount of commercial development was substantial, and the predominant language of residents was English. Two of these relations fit with generally accepted notions about population

TABLE 11: Results of Regression of Urban Development Dimensions on Rate of Population Change, 1951-1961, Eastern Ontario.

Independent Variables		Regression Y_1 Population Change, 1951-1961 b_j	t Value
V_1,	"Physical Development"	1.97236	0.88603
V_2,	"French/English"	- 1.82351	- 2.00229*
V_3,	"Population Age"	14.00688	14.08140***
V_4,	"Industrial/Commercial"	- 4.25962	- 4.29115***
V_5,	"Population Size"	0.73603	0.50304
V_6,	"Education Level"	- 7.15205	- 3.23489**
V_9,	"Compact Development"	2.69858	1.25931
R^2,	Coefficient of Determination	0.8032	
b_o,	A Intercept	132.410	
F	Value	41.9779**	

*** Significant at 1/10 of 1% level.

** Significant at 1% level.

* Significant at 5% level.

change. That is, young populations will have a higher rate of natural increase and/or the young predominate among the migrants to urban places; and the less well-educated tend to have higher birthrates. It is somewhat surprising to note, however, that the more industrial development contributes to the employment and investment base of the community the less likely it is to experience a fast rate of growth in population. Again, what the regression analysis reports as a null hypothesis is also important. Population change rates have little to do with the level of physical development, the compactness of development, or the size of population of a center.

The model made estimates of the 1951-1961 rates of population change within 15 per cent for 55 of the 80 centers. Poorest estimates were for Bloomfield, Braeside, Chesterville, Cornwall, Finch, and Woodville, which were too low, and for Barry's Bay, Chalk River, Deloro, and Madoc, which were too high.

(Since the variable Population Change entered into the factor analysis and emerged as important on the dimension of Population Age, it may be asked whether this significantly affects the regression results. A special test was made to determine the sensitivity of the model in this regard. It showed, first, that the factor structure was not noticeably different with the variable Population Change removed from the original data. Second, the same factors -- i.e., Population Age, Industrial/Commercial Development and Education Level -- continued to provide the bulk of explanation. And, third, the level of explanation (R^2) was reduced by only a small percentage.)

Sub-regional Performance. Taken separately in regression analyses, the two sub-regions had even higher proportions of their population change explained by their dimensions of urban development than in the entire region. The contributing dimensions were, however, virtually the same as for the larger region. For the Lake Ontario Development Region the level of explanation was 86 per cent. This was mostly attributable to three dimensions: Migrant Destination, Religious Affiliation, and Commercial Dominance. That is, in this western sub-region a higher rate of population growth can be expected where the population is predominantly Protestant, English-speaking and older, where the attractions for immigrants are greatest, and where the degree of commercial dominance is highest. The dimension of Migrant Destination is considerably more important than the others.

For the Eastern Ontario Development Region the regression explained over 85 per cent of the variation in population rates of change with the region's dimensions of urban development. In this sub-region only two dimensions had significant associations: French/English and Population Age of which the latter was most important. The regression literally stated that centers with younger and fewer french-speaking residents experienced a more rapid rate of population growth.

These separate regression analyses suggest that when sub-regional distinctions are necessary one should take into account the structure of urban development within the sub-region. The structural features for a larger region may not prove sensitive enough to perceive possible unique characteristics of a sub-region. While there is general consistency between the results of the regional and sub-regional studies here, it is worth noting that facets of Education Level or industrialization did not play a role in the Eastern Ontario Development Region's population change rate. And in the Lake Ontario Development Region the peculiar dimensions of Commercial Dominance and Migrant Destination played important roles.

URBAN STRUCTURE AND RETAIL CHANGE

On the average, among the 80 incorporated centers of the region the rate of growth in retail and commercial establishments during the 1951-1961 decade was less than 4 per cent. This low rate of increase is attributable in large part both to considerable decline in many small centers and changing merchandising and shopping patterns which emphasizes larger units in large centers. Many medium-size centers such as Kingston, L'Orignal, Havelock, Arnprior, and Prescott had the best gains. The range of variation was explained up to 64 per cent by the seven dimensions of urban development (see Table 12). The generally lower level of explanation, compared to population change, is probably due to the complex nature of changes in shopping patterns and in merchandising that have been occurring in this period. That is, the dimensions likely reflect the outcome of interactions of people and stores, suppliers and stores, and stores and stores, that are still not stabilized.

A total of four dimensions are associated with retail changes and some are highly significant. They are, in order of importance: Education Level, Industrial Commercial Development, Physical Development, and Population Size. The relationship, literally stated, is:

an urban center can be expected to experience a faster rate of growth (or lower rate of decline) in retail and commercial establishments when the education level of the adult population is high, when the economic base is commercial rather than industrial, when the level of physical development is not necessarily high, and when the size of population is not high.

At least two of the above relations may be unexpected: that retail growth is low when physical development is low and population size is small. It must be remembered however, that it is the rate of growth that we are concerned with here. In other words, large population centers may not experience a rapid rate of growth in commercial firms even though they may experience an increase of considerable numbers of firms. Ottawa, for example, gained 150 firms in the period, or more than exist in Arnprior. Yet the former gained only 9.5 per cent while the latter gained 27.5 per cent. It is also true, as indicated in other studies, that neither small nor large centers are increasing their share of retail and commercial development as fast as medium-size centers. Regarding the level of physical development and retail change, those centers experiencing a rapid retail expansion may not yet have a high level of urban accoutrements in other respects. Resort centers such as Barry's Bay and Bancroft are good examples of this phenomenon.

Sub-regional Performance. In regression analyses of the rate of change in retail firms in each sub-region, the levels of explanation using their dimensions of urban development, were markedly different. In the Lake Ontario Development Region only 44 per cent of the variation in rates of change were explained. Two dimensions showed a small degree of association with retail change and indicated that it was the more industrial but commercially dominant centers in this sub-region which could expect to expand their retail base (or at least not have it decline so fast). The level of explanation of retail change for the Eastern Ontario Development Region slightly exceeded that for the entire region at 65 per cent. Two dimensions were particularly important -- a high level of physical development and a high degree of specialized activity -- and to a much lesser extent attributes of a large population size and a french-speaking rather than an english-speaking population. These relations are not surprising give the characteristics of numerous french-speaking and special function communities found in the Eastern Ontario Development Region and not found as extensively in counties farther west.

TABLE 12: Results of Regression of Urban Development Dimensions on Rate of Change in Retail Firms, 1951-1961, Eastern Ontario.

Independent Variables	Regression Y_2 Change in Retail Firms, 1951-1961 b_j	T value
V_1, "Physical Development"	-10.56062	-3.09410**
V_2, "French/English"	1.24147	0.88920
V_3, "Population Age"	2.61673	1.71596*
V_4, "Industrial/Commercial"	- 4.91596	-3.23038***
V_5, "Population Size"	- 5.43333	-2.42226**
V_6, "Education Level"	25.98796	7.66734***
V_9, "Compact Development"	0.50905	0.15429
R^2, Coefficient of Determination	0.6444	
b_o, A Intercept	103.718	
F Value	18.6383**	

*** Significant at 1/10 of 1% level.

** Significant at 1% level.

* Significant at 5% level.

URBAN STRUCTURE AND ASSESSMENT LEVELS

In order to determine whether urban structure as defined by the seven dimensions from the factor analysis is associated changes in the investment in physical facilities in a community the change in assessed valuation on private buildings and land was subjected to a regresiion analysis. Data for this performance variable were not available to cover the same period as the other two performance variables and so data for 1956-1963 were used instead. All figures were brought to a more or less uniform basis by applying the equalization index on assessment developed by the provincial government for each community. In the regression covering all of the region's 80 incorporated centers a very low level of explanation, 30 per cent, was obtained. However several highly significant statistical relations were uncovered and prove somewhat illuminating (see Table 13).

A high level of Physical Development appears not to be associated with a high growth rate in assessment, nor does a large Population Size. A high level of Compact Development is closely associated with a rapid expansion of assessed value in physical facilities. (The negative sign on the regression coefficient for the latter dimension represents high density conditions. Dispersed development engenders a positive score on this dimension.) Or, changing the perspective on this relationship, in centers of the same population size, those with more compact development would expand their assessment base more rapidly than those with dispersed development.

Sub-regional Performance. Changes in assessed value for centers in the two sub-regions were tested separately. In the Lake Ontario Development Region no higher level of explanation was obtained than for the larger region. Further, none of the dimensions of urban development for that sub-region displayed any association with the rate of assessment growth. In the Eastern Ontario Development Region, on the other hand, a respectable level of explanation was obtained, 61 per cent. In the latter sub-region, two dimensions contributed most of this explanation: Population Size and Compact Development. Again, as in the larger region, the relation was that more rapid growth in assessed value in a center was experienced where the level of Compact Development was high and the Population Size was small.

In each of the regression tests just reported it is reasonable to assume that the uncertain quality of the assessment data is as much to blame for the low explanations as other causes. Assessment practices vary considerably from place to place within the region. Even with attempts of the provincial government to develop indexes to minimize

TABLE 13: Results of Regression of Urban Development Dimensions on Rate of Change in Assessed Value, 1958-1963, Eastern Ontario

Independent Variables		Regression Y_3 Change in Assessed Value, 1958-1963 b_j	T Value
V_1,	"Physical Development"	-33.75982	- 3.21339***
V_2,	"French/English"	- 9.49391	- 2.20915*
V_3,	"Population Age"	1.00619	0.21436
V_4,	"Industrial/Commercial"	- 1.46792	- 0.31338
V_5,	"Population Size"	-17.84279	- 2.58425**
V_6,	"Education Level"	12.15215	1.16478
V_9,	"Compact Development"	-54.28916	- 5.34570***
R^2,	Coefficient of Determination	0.2981	
b_o,	A Intercept	194.276	
F	Value	4.3676**	

*** Significant at 1/10 of 1% level.

** Significant at 1% level.

* Significant at 5% level.

the variation in assessment totals, the autonomy of the local assessor is known to affect greatly the reliability of this as an aggregate measure. The relations that have been uncovered, although not statistically strong, would still seem to point to the essence of the real relationships.

* * * * *

The regression analyses have revealed some important relationships between the urban structure of centers in Eastern Ontario and two facets of urban growth, population growth and growth in the number of retail establishments. The age of population of center emerged as most strongly associated with the ability of a center to sustain population growth. The level of education and the degree of commercial development in a center were also important for population change. For retail change the degree of commercial development, the level of physical development, the size of population and the level of education were important.

The relevance of these relationships is that, if nothing directly or indirectly occurs to change the performance of the region's centers, then the persistence of conditions giving rise to these five dimensions will affect future performance. For example, cities and towns whose population is old and degree of commercial development low can likely expect little growth in population in the present decade, at least. A second point of relevance is that the relations defined in the regression analysis suggest constraints that will exist on programs for improvement of urban centers. If, for example, it should be desired to increase the rate of population growth in a center, then the degree to which the center possesses a high level of commercial development and an already young population will become important for the success of the program. Hence, these relations are directly relevant to the choice of "growth poles."

PART FIVE

THE IDENTIFICATION OF "GROWTH POLES"

In setting out to identify "growth poles" from among a system of urban centers it is necessary to pose the questions: Growth for what purpose? and What kind of growth? This, of course, projects one immediately into the realm of policy making. The choice of a "growth pole" carries with it implications for the kind of development that is most desirable and the level of performance in urban development that is deemed satisfactory. The maintenance of present urban conditions might be an acceptable objective. Or it might be wished to raise the present level of development in some or all of the region's centers. Or it might be desirable to change the kind of urban development in some or all centers. Answers to the two questions, thus, depend upon being able to state public goals for development and to define policies and programs the minimum level of achievement of these goals. This is a task clearly beyond the scope of this report.

However, it may be possible both to sketch a general perspective on the problem of identifying "growth poles" in public policy and to show how the analyses that have been carried out can assist in the ultimate identification of "growth poles".

To begin with, it is essential to be clear about the notion of "growth poles". The term originated with Perroux in France in 1961.[1] According to his ideas, "growth poles" are industrial centers which create wealth and markets for surrounding regions. This is in contrast to the classic notion of the "central place" as expounded by Christaller, Lösch, etc.[2] The function of a "central place" is to provide commercial, administrative, and government services for their hinterland. One basic distinction between the two concepts is that the "central place" depends upon the level and pace of economic development in its hinterland to stimulate development in the center; the "growth pole" supplies the stimulus for development to its hinterland. An agricultural service center such as Tweed exemplifies the first type; the industrial center of Cornwall exemplifies the second type. There are, of course, very few pure types and most urban centers are a combination of "growth pole" and "central place" for the simple reason that a center's immediate hinterland represents a market for some of the center's economic functions.

Furthermore, both types of urban center can achieve growth, or decline. A viable agricultural or other resource base in the vicinity of a "central place" could stimulate growth beyond the mere servicing of the resource base industries, such as in processing or even manufacturing using local resources. Conversely, a "growth pole" could decline because external forces, say international market conditions, produced an unfavorable situation for the growth industry. And both types of centers could be stimulated by public actions. The "central place" role of a city or town might be enhanced by the concentration of public facilities or regional administrative office there, for example. "Growth poles" might be created through public policy on industrial decentralization, to give another example.

The most important distinction to be made is whether a center is able to receive a stimulus for new growth and to sustain it. Some centers have this capability now by virtue of their size, their present function, their location, or all three. Other centers may have many of the same structural features of urban development but never have had the opportunity for growth. Other centers may have little in the way of favorable attributes for growth. Yet the latter centers may be in locales, that for other reasons, ought to have a growth center. The present analysis has had as its objective the identification of the structural features of urban development that impinge on urban growth, either stimulating or stultifying it.

There remains one more question: What kind of growth? The present analysis has been limited by data problems to growth defined by population change and the change in the number of retail firms in a center. The measure of change in physical investment proved unsuitable and other measures of development such as change in employment in manufacturing industries, or value added, or incomes were simply not available on the statistical basis of individual centers. Population change is still an important criterion of growth and, since it can be translated into total income and into investment needs, it gets at the essence of many development problems.

The remaining discussion is handled in three separate sections, each helping to provide the policy perspective that is necessary in the identification of "growth poles." First, is a discussion of likely urban development problems and problem centers; next, there is a discussion of the relation between urban structure and rural poverty in the region; and, finally, a profile of the urban development conditions in an accepted growth center is constructed from the urban development dimensions.

URBAN PROBLEMS AND PROBLEM CENTERS

It is possible to get at the nature of urban development problems and to identify the communities that are affected by them through the factor analysis. In the first place, three of the dimensions reflect conditions that are generally considered important to strive for: Physical Development, Compact Development, and Educational Attainment. In the second place, there are two dimensions that have an important bearing on economic development: Population Age and Industrial/Commercial Development. Through an examination of the first three dimensions referred to above, one may describe more fully several problem situations of the present (and future, if no changes are made); while the latter two dimensions appear more potential problems.

Some Current Problems and Their Complexity

It is usually deemed desirable for urban communities to possess a high level of physical development, to be compactly developed, and for their populations to possess a high level of education. Since there are urban development dimensions from the present analysis which are related directly to these goals, it is possible to use the level of achievement on these dimensions as a measure of the degree of success in attaining the goals. Probably more important than just indicating a high or low score of performance on these dimensions is to be able to show the complex relations of variables (people, jobs, housing, etc.) which are present and interact to produce the scores. For where any of the pertinent variables are absent or deficient a desirable level of achievement may not be attainable.

The problem of low physical development, for example, among the urban centers of Eastern Ontario can be defined as comprising conditions of low average value of dwellings, many dwellings without furnace heat and/or hot and cold water, poor quality of high school, and few public services initiated by the local community. This problem syndrome also includes adult populations lacking high school education, a low average level of family earnings, and a labor force with a relatively high proportion of female participation. If lack of compactness in urban development were considered a problem, it would have to be seen as a combination of low population density and few high-value buildings in the built-up area of the center associated, in turn, with a lack of highway access to other centers of the region. Where the level of educational attainment is considered a problem, it will be found intertwined with the level of family earnings and the per capita capital investment in the community.

With the interrelations of the various problems thus illuminated, it becomes obvious that the problem solving will not be within the purvey of a single agency, program or profession, as we presently know them. The problem of physical development is bound up as much with schools and education as it is with housing, local government, and jobs. It will require the economist, public administrator, educationalist, and city planner all to be involved in developing a solution. Compactness demands policies for city planning and highways with a liberal assist from entrepreneurs willing to invest in the community. And educational attainment shows up as much more than a problem of teachers, curricula, and school buildings. Jobs and capital investment must also be accounted for in the education policy.

Assuming that scores in the two lowest quintiles of the three urban development dimensions just mentioned represent problem situations, the communities with these problems may be located on a map (see Table A-1 for scores of all centers). Poor Physical Development affects a majority of centers in the easternmost counties: Alfred, Athens, Casselman, Lanark, L'Orignal, Maxville, Newboro, Vankleek Hill, and Merrickville have the worst conditions in that area. Another cluster of centers in the Hastings-Northumberland-Prince Edward-Lennox and Addington counties area are similarly affected: Bloomfield, Desoronto, Havelock, Hastings, Newburgh, Frankford, and Wellington. A number of centers scattered in or near the Canadian Shield area also show up with poor Physical Development: Barry's Bay, Beachburg, Deloro, Killaloe Station, Omemee, and Woodville. A lack of Compact Development affects almost all these same centers just as strongly. Finch and Braeside would have to be added to the eastern centers and Madoc and Millbrook to those places in the central counties. Low levels of education are also found to exist in most of the centers already mentioned. Rockland and Bobcaygeon are the only notable additions. (See Figures 5, 10, and 11.)

According to our criteria these are the "problem centers" of the Eastern Ontario Region. That is, given a continuation of present trends these communities have poor prospects for improving their urban development situation. When it is noted that seventeen of the centers mentioned also fall into the two lowest quintiles of the Population Age dimension, indicating the predominance of elderly residents, their prospects for adding to their population are indeed low. The regression analyses have confirmed this. If, in addition, any of these centers are industrialized to a high degree, their level of retail services is also likely to decline. The selection of any of these "problem centers" as a "growth pole" must, therefore, be carefully considered. Substantial resources will be required just to right the imbalance in urban development from which these centers currently suffer.

Implications for Programs of Improvement

If efforts are made to improve, or otherwise change, the urban development situation in the region's centers, these efforts will have to start with conditions that presently exist. It may turn out that some existing conditions would prove to be constraints on an improvement program. One very likely constraint is the age of the population, for this is closely tied to labor force skills, mobility, and so forth. From the position of a center on the Population Age dimension it is possible to determine whether this might prove to be constraining to future development. Of course, a relatively old population in a center where the industrial development opportunities demanded younger workers may not deter location of the industry in the center. But it may portend two consequences: either workers would be attracted to commute from other centers and/or there would be an influx of new residents into the community to take up the employment opportunities. The converse of such a situation is that where the population of a center is relatively old it may not be mobile enough to take advantage of expanded opportunities in nearby centers.

A large proportion of the centers in Eastern Ontario are characterised by having an economic base that is either substantially devoted to industrial activities or to activities associated with performing commercial or public services. From the regression analyses there is evidence that commercial centers are more likely to be able to sustain a fast rate of growth in population and in retail establishments than industrial centers. One clear implication of this is that industrial development need not be seen as the only economic base orientation leading to expansion of population or retail firms.

There are many programs of planned change which could be affected adversely by conditions of urban development existing at the present time. The various analyses describe these conditions and should, therefore, be brought into the policy perspective when formulating plans for the future of urban centers.

URBAN STRUCTURE AND RURAL POVERTY

In the recent work of Professor Berry of the University of Chicago, studying rural poverty in Eastern Ontario, he identified three facets of the problem. The first had to do with poverty associated with the population that lived on farms; the second concerned poverty associated with rural people who did not reside on farms, the non-farm portion of the rural population; and the third he termed social disadvantage. In each case, through a factor analysis, he was able to distinguish the main dimensions of rural development for all the townships of Eastern Ontario. On the dimension indicating rural farm poverty and prosperity he found the level of poverty of townships related to their endowment of resources. Poor soils, in particular, were highly correlated with low scores on this dimension. Social disadvantage showed up prominently in the townships of the easternmost tip of the region and associated with French occupancy. Poverty of rural non-farm populations was, in Berry's opinion, related to the distribution of urban centers, with more non-farm poverty prevailing as the distance from a large center offering employment opportunities increased.

The latter contention of Berry concerning the incidence of rural non-farm poverty was tested in the present study. The aim was to determine whether any correlation existed between townships Berry designated as non-farm poverty areas and conditions of urban development that had been identified by the dimensions of urban development uncovered here. The township within which the incorporated center was located was identified and its score on the rural non-farm poverty dimension recorded as falling above or below the mean. These binary scores were correlated with scores for the center on each of the seven dimensions of urban development as they fell above or below the mean. The following correlations were found:

RURAL NON-FARM POVERTY and,

1) Poor Physical Development, $r = 0.56$
2) French-speaking center, $r = 0.58$
3) Old population, $r = 0.84$
4) Industrial orientation, $r = 0.60$
5) Small population, $r = 0.65$
6) Poor Education, $r = 0.73$
7) Lack of compactness, $r = 0.70$.

If, as stated at the outset that the future of rural areas is entwined with that of urban centers, then these findings have a great deal of relevance for development policy. The above correlations state, very clearly, that poor rural areas are more than likely to be confronted with poor urban centers. This can only be construed as a great disadvantage for poor rural areas to not have a strong urban system upon which to base their own improvement programs. It may be fair even to suggest that poorly developed urban centers are an important cause of poverty for rural non-farm groups. At the very least, they provide little opportunity for the non-farm population to better themselves.

For the choice of "growth poles" these relations between rural poverty and poor urban development are very pertinent. A decision to stimulate growth in selected urban centers in the rural poverty areas could have a beneficial effect all around. But such centers will undoubtedly have to be highly subsidized in their development for some time in order to bring them up to a satisfactory level so as to start having beneficial effects on surrounding areas. The alternative of spreading the benefits of growth to rural poverty areas from more well-endowed centers does not seem applicable to large portions of the rural poverty areas, if only for the distances involved for commuting, etc.

Among the centers for which policies on rural poverty will have some impact are, from the east: Maxville, Casselman, Finch, Winchester, Athens, Newboro, Westport, Desoronto, Wellington, Tweed, Madoc, Hastings, Norwood, Havelock, and Frankford.

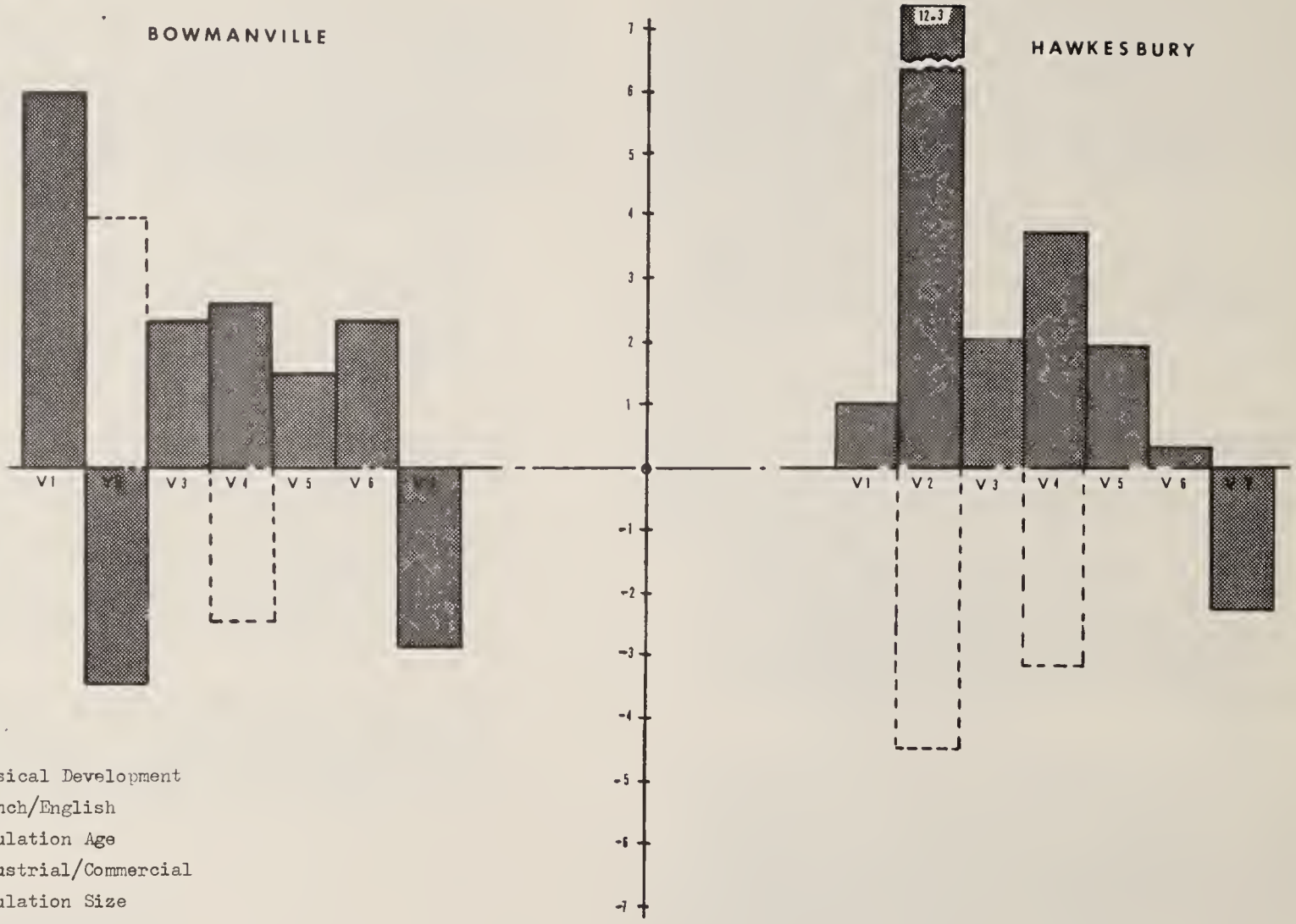
A PROFILE OF URBAN GROWTH

The theme of the final section of this report has been that the identification of "growth poles" is a relative question. It is relative to public goals of what kind of growth, what level of performance, and in what locations. These questions cannot be answered here. But it has also been contended that the present structure of urban development will strongly affect future urban development. In this sense it is possible to suggest, in an admittedly limited way, the main structural features of a center that has good prospects for future growth given a continuation of present trends.

Two centers from considerably different areas of the region have been selected to illustrate the configuration of urban structural features that seem best to promote growth. The two centers are Bowmanville and Hawkesbury; the first is a predominantly english-speaking center and the second is predominantly french-speaking. It is largely to show that language and cultural differences make little or no difference to growth potential that these contrasting centers are used. Also, neither is a very large center, although their profile of urban development is similar to ones that could be constructed for Peterborough or Cornwall, for example. The scores for each of the centers are depicted graphically in Figure 12.

The profiles of scores obtained by each of the sample centers are intended to provide an approximation of the kind of urban development structure that is most conducive to growth. These are not ideal types of centers in the accepted usage of that term, but it is fair to say that a center with a profile such as these could expect to grow well. Furthermore, there are two facets of urban development that might be radically different and growth could still have a good chance. Language differences could reverse the score of a center on the French/English dimension and the economic base could just as well be commercial according to the Industrial/Commercial Development dimension. Apart from these two qualifications, the profiles could be used as an important first approximation of growth potential.

PROFILES OF URBAN GROWTH



V_1 Physical Development
V_2 French/English
V_3 Population Age
V_4 Industrial/Commercial
V_5 Population Size
V_6 Education Level
V_7 Compact Development

FOOTNOTES

Part One:

1. B.J.L. Berry and H.G. Barnum, "Aggregate Relations and Elemental Components of Central Place Systems," JOURNAL OF REGIONAL SCIENCE, 4(Summer 1962), 35-68.

2. Douglass C. North, "Location Theory and Regional Economic Growth," JOURNAL OF POLITICAL ECONOMY, 63(June 1955), 243-258.

3. G. Hodge, "Urban Systems and Regional Policy," CANADIAN PUBLIC ADMINISTRATION, June 1966.

4. Ontario, Dept. of Economics, ECONOMIC SURVEY OF EASTERN ONTARIO REGION, (Toronto: Queen's Printer, 1960). ECONOMIC SURVEY OF LAKE ONTARIO REGION, (Toronto: Queen's Printer, 1961).

5. For a review of the pertinent literature see, G. Hodge, "Do Villages Grow?", RURAL SOCIOLOGY, 31(June 1966), 183-196.

6. B.J.L. Berry, "The Identification of Areas of Rural Poverty," in AREAS OF ECONOMIC STRESS IN CANADA, R. Thoman, ed., (Kingston: Queens University, 1965).

Part Two:

1. Data on the commercial structure of centers is from the Dun and Bradstreet, REFERENCE BOOK, January 1961.

2. See, for example, John R. Borchert, TRADE CENTERS AND TRADE AREAS OF THE UPPER MIDWEST, (Minneapolis: Upper Midwest Economic Study, 1963), Urban Report No. 3.

Part Five:

1. Francois Perroux, "Les Poles de croissance," L'ECONOMIE DU XX SIECLE, Paris, 1961.

2. For a complete bibliography on central place studies see, B.J.L. Berry and Allen Pred, CENTRAL PLACE STUDIES, (Philadelphia: Regional Science Association, 1961).

APPENDICES

DESCRIPTIONS OF VARIABLES USED IN THE STUDY AND THEIR SOURCES

From discussions held in the early stages of this study it was apparent that many variables are involved in the performance of an urban center. Over sixty were suggested initially. Some had to be rejected for lack of data despite their seeming relevance (i.e., income levels, manufacturing activity, community leadership, and various measures of physical facilities). Others were discarded when further examination showed them to be duplicates of measures already included.

The variables are listed below with a brief definition and an indication of their source. They are designated by the prefix "x" and a subscript number referring to their order in each factor and by a code name. Unless otherwise noted, the measure refers to the area within the municipal boundaries of the centers under study.

x_1, Population Size, 1961 (POPULA); Census of Canada.

x_2, Population Change, 1951-1961 (POPCHA); Census of Canada.

x_3, Population Under 15 Years, 1961 (POPU15), Census of Canada.

x_4, Population Over 65 Years, 1961 (POPO65), Census of Canada.

x_5, Population Protestant, 1961 (POPROT), an aggregate of all protestant denominations, Census of Canada.

x_6, Population Roman Catholic, 1961 (POPRCA), Census of Canada.

x_7, Population French Speaking, 1961 (POPFRE), Census of Canada.

x_8, Population English Speaking, 1961 (POPENG), Census of Canada.

x_9, Population Immigrant Since 1945, 1961 (PIMM45), Census of Canada.

x_{10}, Educational Attainment I: University Degree, 1961 (UNIVER), expressed as a proportion of the population over 25 years, Census of Canada

x_{11}, Educational Attainment II: Grade 11, 1961 (GRAD11), expressed as a proportion of the population 16 years and over, Census of Canada.

x_{12}, Population Density, 1961 (POPDEN), expressed as a ratio of 1961 population to the acreage of the built-up area, Ontario Dept. of Municipal Affairs and Canada Dept. of Mines and Technical Surveys.

x_{13}, Value of Physical Development, 1964 (CAPINV), total taxable assessment (equalized) per capita, Ontario Dept. of Municipal Affairs.

x_{14}, Intensity of Physical Development, 1963 (INTASS), total taxable assessment (equalized) per acre of built-up area, Ontario Dept. of Municipal Affairs.

x_{15}, Investment in Utilities, 1963 (UTILIT), assets in sewerage and water systems per capita; Ontario Dept. of Municipal Affairs.

x_{16}, Level of Locally Provided Services, 1963 (LOCSER), Ontario Dept. of Municipal Affairs.

x_{17}, Investment in Commercial Property, 1961 (INCOMM), commercial property assessment as a proportion of total assessment (equalized), Ontario Dept. of Municipal Affairs.

x_{18}, Investment in Industrial Property, 1961 (ININDU), industrial property assessment as a proportion of total assessment (equalized), Ontario Dept. of Municipal Affairs.

x_{19}, Median Value of Dwelling Units, 1961 (MVALDU), Owner-occupied units only, Census of Canada.

x_{20}, Dwelling Units Built Before 1945, 1961 (DUSOLD), Census of Canada.

x_{21}, Dwelling Units With Furnace Heat, 1961 (DUFURN), Census of Canada.

x_{22}, Dwelling Units With Hot-Cold Water, 1961 (DUHCWA), Census of Canada.

x_{23}, High School Quality, 1963 (HSQUAL), proportion of teachers with advanced teaching certificates, Ontario Dept. of Education.

x_{24}, Hospital Quality, 1964 (HSPQUA), number of rated (OHSC) beds per 1000 population, Ontario Hospital Services Commission.

x_{25}, Location of Nearest Competing Center, 1961 (NEARES), mileage by road to nearest center of same or higher class, maps.

x_{26}, Time-Distance to Nearest Metropolis, 1961 (NMETTD), travel time by road to Ottawa, Toronto, or Montreal, maps

x_{27}, Highway Access, 1964 (HIGHWA), an index combining highway type on which center is located and nodality of center, maps.

x_{28}, Labor Force Employed in Manufacturing, 1961 (EMPMAN), Census of Canada.

x_{29}, Labor Force Employed in Services, 1961 (EMPSER), an aggregate of total trade, finance, real estate, total services, public administration, and defence employment, Census of Canada.

x_{30}, Average Family Earnings, 1961 (FAMERN), Census of Canada.

x_{31}, Male/Female Employment Ratio, 1961 (EMPSEX), Census of Canada.

x_{32}, Level of Retail Services, 1961 (LEVRET), expressed as the number of retail and commercial service establishments, Dun and Bradstreet.

TABLE A-I: Scores of Incorporated Centers on Dimensions of Urban Development, Eastern Ontario

CANONICAL VARIATES

CENTER	V_1	V_2	V_3	V_4	V_5	V_6	V_7
ALEXAN	- 2.30	10.04	- 2.22	- 0.60	0.05	- 2.77	-0.13
ALFRED	- 7.51	15.47	- 0.99	- 3.75	- 2.40	- 3.92	-0.85
ALMONT	0.02	- 0.91	- 1.27	- 0.01	- 0.92	- 0.01	0.47
ARNPRI	2.69	- 0.37	1.28	2.77	1.38	1.90	-1.09
ATHENS	- 3.30	- 3.18	- 3.15	0.65	- 2.48	- 1.89	2.57
BANCRO	0.45	- 0.22	5.15	- 4.15	2.49	0.83	0.58
BARRYB	- 9.43	6.75	- 0.56	- 4.04	- 3.71	- 5.53	3.35
BATH	- 0.71	- 4.49	5.01	1.01	- 0.81	1.83	- .26
BEACHB	- 4.14	- 3.78	- 4.43	- 0.53	- 3.57	- 4.10	3.92
BELLEV	6.50	- 2.09	3.63	0.29	4.45	3.33	-4.39
BLOOMF	- 5.46	- 2.62	- 3.86	4.05	- 3.63	- 2.67	2.53
BOBCAY	- 2.29	- 3.21	- 5.93	- 2.62	- 1.41	- 2.48	2.10
BOWMAN	5.95	- 3.45	2.36	2.60	1.95	2.33	-2.88
BRAESI	- 4.46	2.40	- 2.34	10.76	- 2.81	- 1.48	3.95
BRIGHT	- 0.37	- 2.33	0.11	- 1.11	- 1.07	- 0.76	0.28
BROCKV	7.67	- 3.02	2.86	1.65	4.09	4.35	-5.04
CAMPBE	0.93	- 2.83	- 2.86	0.29	- 0.85	- 1.33	0.83
CARDIN	- 0.68	- 1.82	- 0.65	8.05	- 1.29	0.22	0.70
CARLET	1.63	- 2.28	- 2.99	0.39	- 0.28	- 0.29	-0.38
CASSEL	- 4.39	12.75	- 1.46	- 0.88	- 2.57	- 3.57	2.30
CHALKR	- 3.72	3.00	6.03	- 3.54	- 2.71	- 2.08	2.16
CHESTE	- 0.61	- 1.26	- 2.52	3.29	- 0.21	0.88	1.25
COBDEN	- 0.67	- 2.64	- 1.66	- 1.77	- 1.17	- 1.17	0.82
COBOUR	6.12	- 2.39	2.27	1.32	2.60	3.23	-3.57
COLBOR	- 0.24	- 3.91	- 2.94	- 1.13	- 1.04	- 1.01	0.57
CORNWA	4.61	6.40	6.02	1.02	5.59	0.66	-5.13
DEEPRI	9.66	- 1.53	15.02	- 5.36	4.15	14.76	-3.58
DELORO	- 6.90	0.47	2.44	10.59	- 4.79	0.91	7.01
DESERO	- 4.95	- 1.43	- 2.37	2.73	- 3.74	- 4.04	2.91
EASTVI	8.17	10.87	8.90	- 1.73	6.12	5.56	-16.85
EGANVI	- 2.33	0.61	- 1.20	- 2.07	- 1.52	- 2.35	2.07
FENELO	- 1.26	- 2.95	- 4.85	- 1.84	- 1.40	- 1.62	2.11
FINCH	- 2.85	- 1.47	- 4.76	- 2.23	- 2.02	0.83	3.05
FRANKF	- 3.49	- 2.03	- 0.23	1.91	- 2.63	- 3.08	1.84
GANANO	4.42	- 2.08	- 0.54	1.78	2.13	2.45	-3.37
HASTIN	- 5.64	- 0.52	- 4.54	- 0.42	- 3.22	- 4.07	3.70
HAVELO	- 4.57	- 1.93	- 4.22	- 1.52	- 2.59	- 3.08	3.00
HAWKES	0.97	12.30	2.06	3.70	1.89	0.28	-2.24
IROQUO	5.33	- 3.36	1.89	4.57	1.24	4.23	-2.17
KEMPTV	2.31	- 2.84	- 1.74	- 1.62	0.67	1.69	- .43
KILLAL	- 7.12	2.96	- 2.30	- 2.88	- 3.38	- 5.18	3.41
KINGST	9.31	- 2.81	3.62	- 0.52	8.08	6.61	-7.54
LAKEFI	- 0.16	- 2.22	0.37	0.28	- 1.08	0.39	1.16
LANARK	- 7.19	0.09	- 2.97	1.98	- 4.25	- 6.15	5.05
LANCAS	- 2.93	6.96	- 1.88	- 2.78	- 0.80	0.31	1.08
LINDSA	3.83	- 2.58	- 1.07	1.00	2.85	1.50	-1.
LORIGN	- 4.93	12.02	1.35	- 0.35	- 2.36	- 3.26	0.97
MADOC	- 2.23	- 1.06	- 0.61	- 2.78	- 2.08	- 0.97	3.15

TABLE A-I: cont.

CENTER	V_1	V_2	V_3	V_4	V_5	V_6	V_7
MARMOR	- 2.22	- 0.64	- 0.63	- 1.18	- 1.73	- 1.78	2.15
MAXVIL	- 4.06	2.50	- 4.44	- 2.43	- 3.01	- 2.60	3.87
MERRIC	- 3.00	- 2.46	- 3.78	- 0.95	- 1.81	- 2.07	1.39
MILLBR	- 1.54	- 3.19	- 2.75	- 1.26	- 2.82	- 1.98	3.94
MORRIS	2.03	- 2.27	- 0.30	- 0.53	0.15	1.17	-1.04
NAPANE	2.97	- 2.92	- 1.77	0.02	2.04	1.89	-2.65
NEWBOR	- 6.38	- 1.45	- 6.23	- 3.18	- 4.32	- 6.07	4.45
NEWBUR	- 6.90	- 1.31	- 1.57	2.60	- 4.25	- 2.40	4.53
NEWCAS	0.14	- 3.58	1.41	2.07	- 1.24	- 0.53	0.17
NORWOO	- 0.06	- 3.03	- 2.85	- 0.87	- 1.78	- 0.70	1.82
OMEMEE	- 3.49	- 2.35	- 2.29	2.17	- 2.71	- 3.47	2.64
OTTAWA	16.29	2.43	6.39	- 1.04	29.82	12.78	-15.58
PEMBRO	3.78	2.00	2.28	- 0.75	3.74	1.58	-3.48
PERTH	3.75	- 1.57	- 1.90	0.47	1.03	0.77	-2.47
PETAWA	- 2.48	2.18	13.57	- 5.98	- 2.05	0.06	3.06
PETERB	8.24	- 1.82	2.29	3.44	7.49	5.20	-7.04
PICTON	1.99	- 2.57	- 1.31	- 2.22	1.30	1.11	-0.36
PORTHO	5.28	- 4.08	1.18	2.98	1.62	2.94	-1.91
PRESCO	5.09	- 1.87	3.36	3.38	2.06	3.09	-3.86
RENFRE	1.75	0.85	0.40	1.38	0.86	0.17	-0.35
RICHMO	2.17	- 2.02	6.14	- 0.19	- 0.97	1.56	0.90
ROCKLA	- 2.75	13.02	1.66	- 2.84	- 0.79	- 2.71	-0.30
SMITHF	4.58	- 1.72	- 0.79	- 0.36	2.36	1.86	-3.39
STIRLI	2.30	- 4.22	- 1.77	- 0.42	- 0.39	0.08	-0.22
STITTS	2.74	- 3.32	13.21	- 1.66	- 0.42	2.76	0.31
TRENTO	4.08	- 1.55	3.18	0.56	2.00	1.81	-2.95
TWEED	0.58	0.63	- 0.80	- 1.84	- 1.12	- 0.53	1.18
VANKLE	- 3.73	7.82	- 2.94	- 1.12	- 2.14	- 2.06	2.13
WELLIN	- 3.71	- 3.41	- 4.24	- 0.16	- 2.22	- 1.41	2.35
WESTPO	0.59	0.03	- 2.97	- 3.68	0.74	1.48	-0.10
WINCHE	2.05	- 4.04	- 2.82	- 2.03	1.01	0.60	0.05
WOODVI	- 3.86	- 3.56	- 6.20	- 0.83	- 3.39	- 2.82	3.77

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